NSW Centre for Public Health Nutrition

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Soft Drinks, Weight Status and Health: A Review

The University of Sydney

NSW HEALTH

The NSW Centre for Public Health Nutrition is funded by the NSW Department of Health and supported by the Sydney Nutrition Research Foundation

SOFT DRINKS, WEIGHT STATUS AND HEALTH: A REVIEW

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A NSW Centre for Public Health Nutrition project for NSW Health

Suggested citation: Hector D, Rangan A, Louie J, Flood V, Gill T (2009). Soft drinks, weight status and health: a review. Sydney: A NSW Centre for Public Health Nutrition (now known as Cluster of Public Health Nutrition, Prevention Research Collaboration, University of Sydney) project for NSW Health.

SHPN (CHA) 090049
ISBN 978 1 74187 356 6

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June 2009

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ABBREVIATIONS

BMI	Body mass index
CAPS	Childhood Asthma Prevention Study
FSANZ	Food Standards Australia New Zealand
HFCS	High-fructose corn syrup
NNS	National Nutrition Survey
OR	Odds ratio
SEIFA	Socio-Economic Indexes for Areas
SES	Socio-economic status
SMILE	Study on Medical Information and Lifestyle in Eindhoven
SPANS	Schools Physical Activity and Nutrition Survey
WIC	Women, Infants and Children

Soft Drinks

The term 'soft drink' in this report refers to carbonated beverages. If no adjective is used, then the term refers to regular or sugar-sweetened soft drinks. In Australia, the sugar added is sucrose.

However, some of the literature uses the term 'soft drinks' to include artificially sweetened or 'diet' carbonated beverages. Where this is the case, we have clarified meaning in the surrounding text. Other terminology includes 'sugary drinks' or 'sugar-containing drinks' — terms which encompass carbonated sugar-sweetened soft drinks as weell as fruit juices, fruit drinks, cordials, sports drinks, energy drinks and iced teas.

Throughout this report, amounts of soft drinks are expressed in millilitres (1mL = approximately 1 gram).

Executive Summary

The prevention of overweight and obesity, particularly among children, is a public health priority. A range of initiatives to address this problem have already been developed and implemented in NSW. However, a broader range of additional strategies are needed to effectively address this complex issue.

The high consumption of soft drinks, i.e. sugar-sweetened carbonated beverages, and other sugary drinks is one of an array of dietary behaviours which has been identified by a number of policy documents as an important, specific behaviour to address in the prevention and management of obesity.

This report aimed to:

- indicate how much soft drink is being consumed in NSW and Australia and by whom
- examine the reasons why soft drinks are consumed
- provide an overview of the health consequences of a high consumption of soft drinks, particularly the evidence relating soft drink consumption to overweight and obesity
- explore behaviour change options and strategies to reduce soft drink consumption.

Australia is a high consumer of soft drinks; among the top 10 countries for per capita consumption. Sales data indicate that consumption of soft drink has remained relatively stable in the recent past. Detailed information from the 1995 National Nutrition Survey shows that young males and adolescents are the highest consumers, consuming almost one litre (approximately 3 cans) per day. Boys consume significantly more soft drinks than girls. Young adult males aged 19–24 years are the next highest consumers of soft drinks. Consumption of soft drinks in 1995 was highest among the most socio-economically disadvantaged adults and differed between states and territories, but not between urban and rural/remote regions, in Australia. Smaller studies indicate that boys of Middle Eastern and Southern European descent and Aboriginal and Torres Strait Islander communities are high consumers of soft drinks. Also, one study in NSW showed that a large proportion of toddlers aged 16–24 months consumed soft drinks. In the most recent data reported from the NSW Population Health Survey (2005–2006)
20 per cent of 9–15 year olds reported regularly consuming more than 1.5 cups of sugary drinks per day.

Taste is reported to be a key factor in the decision by adolescents to choose soft drinks over other beverages but parenting style and practices and parental consumption are also important. Other important factors associated with increased intake are the availability of soft drinks (especially in the home), portion size (including the small price differential for larger portions) and exposure to marketing. There is little information about the determinants of soft drink consumption among subgroups other than adolescents.

There has been some contention over the strength of the evidence linking soft drink consumption to overweight and obesity. However a number of recent, comprehensive systematic reviews and meta-analyses have shown that the evidence is present in a large number of studies of various types, with studies of increasing methodological power showing increasing strength of association. No studies showed a negative association. A strong biological plausibility supports the relationship. High levels of soft drink consumption have been linked to a range of other ill-health consequences including type 2 diabetes, metabolic syndrome, osteoporosis, dental caries, and the displacement of healthier food and beverage options from the diet. Other health benefits are therefore likely to result from an investment in reducing soft drink consumption.

There is sufficient evidence of the potential benefits of reducing soft drink consumption to warrant action on this issue. New South Wales, along with some other Australian states, has already imposed a ban on the sale of soft drinks in public schools. However, further strategies are needed as most soft drink consumption is likely to occur outside of schools. There is currently little intervention evidence to inform action, hence a range of innovative initiatives are required.

The lack of awareness concerning the ill-health consequences of soft drink consumption and lack of

desire to change this behaviour could be addressed through a social marketing campaign. Formative research is needed to inform such a campaign, and the campaign should have a long-term focus. There are four behaviour change options, or 'messages', to consider:

- Reduce frequency and quantity of soft drink consumption
- Replace soft drinks with artificially-sweetened drinks
- Replace soft drinks with water
- Reduce uptake of soft drink consumption by young children.

There are disadvantages to most alternative beverages to soft drinks, other than water and reduced fat milk.

Without supporting environmental changes, individual-level behaviour changes are unlikely to occur and be sustained. Key policy and structural issues that could influence soft drink consumption include: restricting access (including reducing availability/visibility); pricing strategies; reducing portion sizes; restricting marketing to children (including through sponsorship and fundraising); improving labelling or nutrition signposting; and the reformulation of products to include less sugar.

In summary, reducing soft drink consumption is one of a number of important behaviours to address in the prevention of overweight and obesity. A number of conclusions are drawn which can inform action in this area. These relate to: target populations; implications for qualitative research; a public education/social marketing campaign; innovation and applied research for promising approaches; environmental changes; and, monitoring.

Section 1

Introduction

1.1 Background

This report is one of a series of reports by the NSW Centre for Public Health Nutrition (CPHN) requested by NSW Health to support evidence-based policy and planning in public health nutrition.

This report complements and expands upon one of the modules within the recent evidence updates produced by the Prevention Research Centres (**http://www.coo.health.usyd.edu.au)** which reviews the evidence for interventions to reduce the consumption of sugary drinks and increase the intake of water in children. It also supports the report *Best Options for Promoting Healthy Weight and Preventing Weight Gain in NSW* (Gill et al. 2005).

The 2006 *NSW State Plan, A New Direction for NSW* identifies the prevention of childhood overweight and obesity as a priority (Priority S3). The Plan aims to prevent an increase in the prevalence of childhood overweight and obesity (currently 25 per cent) in NSW over the next 5 years, and to reduce levels to 22 per cent by 2016.

Sugar-sweetened soft drinks and fruit juices have been identified as one of the dietary contributors to overweight and obesity (Joint WHO/FAO Expert Consultation 2003). This report stated that each can of soft drink consumed per day increases the risk of being obese by 60 per cent. Other public health organisations have acknowledged the link between the consumption of sugar-sweetened beverages and obesity and have advised a reduction in intake of such beverages to help prevent weight gain (Joint WHO/FAO Expert Consultation 2003; Committee on Prevention of Obesity in Children and Youth 2004; Murray et al. 2004; Dietary Guidelines Advisory Committee 2005).

Other dietary behaviours which likely contribute to overweight and obesity include the over-consumption of energy-dense nutrient-poor foods (often consumed outside of meals as snacks), the low consumption of fruit and vegetables, and the lack of family meals. Low levels of physical activity and high levels of sedentary activity also contribute to an energy imbalance.

Over-consumption of any sugary drink has the potential to lead to an energy imbalance. However soft drinks can be singled out for specific attention as a possible target of population-level obesity-prevention programs for a number of reasons. First, sugar-sweetened carbonated beverages, or soft drinks, are the most popular water-based beverages in Australia. International market research data indicates Australia is ranked among the top 10 countries for per capita consumption of soft drinks (*Beverage Digest* 2006). Second, they are well-identified products that are readily available and marketed extensively, especially to teenagers. Third, sugar-sweetened soft drinks are a common source of sugar and energy, with one regular can containing 10 teaspoons of sugar and 640 kJ (150 cal), but provide no other nutritional value other than fluid — so-called 'empty' calories (Jacobson 2005). They are identified as an 'extra' food in *The Australian Guide to Healthy Eating* (NHMRC 2003a; 2003b), i.e. a food that should be consumed only occasionally and in small amounts. Occasionally has been defined as 'once a week or less' by The Communication on Obesity Action for Child Health (COACH) Reference Group (Wilde et al. 2007), which represented the major NGO and professional groups communicating on childhood obesity issues in Australia.

The beverage industry contends that 'soft drinks have a valuable hydration role in a continent that experiences mostly temperate weather with many extremes of heat' (Australian Beverages Council 2004). However, the need for hydration could normally be adequately filled by other beverages without the accompanying sugar and energy content, such as water. Moreover, soft drinks are less hydrating than water.

1.2 Purpose

This report appraises a broad range of issues relating to soft drink consumption, and reflects information and the literature available up to mid-2008. The report is not an exhaustive review but is intended to stimulate consideration of some of the wider issues associated with reducing soft drink consumption. It provides an overview of current knowledge surrounding the relationship between soft drink consumption and weight status and other health implications, and reports on the nature and extent of soft

drink consumption in NSW and Australia. It considers the factors affecting soft drink consumption. It aims to build on the evidence-base for interventions to reduce soft drink consumption, which is currently extremely limited, by examining some broader ideas for interventions and strategies that might impact on this problem.

Specifically this report addresses the following questions:

- Who consumes soft drinks and how much is consumed?
- Why are soft drinks consumed?
- What are the ill-health and other consequences of soft drink consumption?
- How could we reduce the consumption of soft drinks?

Soft drinks are chosen as the focus of the review and are targeted for desirable behaviour change. However, other sugary beverages such as cordials, fruit drinks, fruit juices, energy drinks and sports drinks are also discussed as they have the potential to contribute to an energy imbalance.

The information in this report can be used to support evidence-based policy and planning as part of a portfolio of interventions aimed to reduce the prevalence of overweight and obesity and contribute to a healthier diet.

Section 2

Soft Drink Consumption in NSW and Australia

Data relating to soft drink consumption in Australia and NSW are obtained from a number of sources including the most recent national dietary survey, state-level population surveys, a number of smaller-scale surveys and retail sales data (Table 1).

Table 1: Summary of Australian sources of data on consumption of soft drink (*ordered according to appearance in current report*)

Source	Description
Apparent consumption data; Australian Bureau of Statistics 2000	Apparent consumption data are estimates of per capita consumption derived using information relating to the supply (production, change in stocks, imports), and utilisation (exports, non-food use, and use in processed food) of foods
Australian Beverages Council website	Information on average per capita consumption of soft drinks obtained from sales data
Australian Beverages Council; McPherson 2005	Report containing sales data used to estimate trends in energy intake
Euromonitor report; Euromonitor International 2006	Market report on retail sales data
Levy and Tapsell 2007	Research paper used sales data from the Australian beverage industry to describe trends in purchasing patterns of non-alcoholic, water-based beverages, 1997–2006.
National Nutrition Survey 1995; Australian Bureau of Statistics 1998	Most recent Australian national nutrition survey, used a standardised 24-hour recall to obtain dietary intake data from 3008 children and 10,851 adults
NSW Population Health Surveys; NSW Department of Health 2002 and 2008	The New South Wales Population Health Survey is an ongoing telephone survey which monitors population health. Short questions are used to monitor intakes of selected foods including sugary drinks.
Consumption of intense sweeteners in Australia and New Zealand report; FSANZ 2003	Phone survey, carried out by Roy Morgan Research, investigated consumption patterns and exposure to intense sweeteners among Australians and New Zealanders aged 12 years and over. Short questions were used to examine consumption of sugar-sweetened and intensely-sweetened soft drinks.
Schools Physical Activity and Nutrition Survey; Booth 2006	NSW health survey of 5500 schoolchildren aged 5–16 years. Dietary intake was assessed using a series of short questions among 11–16 year old students.
Childhood Asthma Prevention Study; Webb 2006	This study examined dietary intake using 3 day weighed food records of 429 toddlers aged 16–24 months in Western Sydney

2.1 Apparent Consumption Data

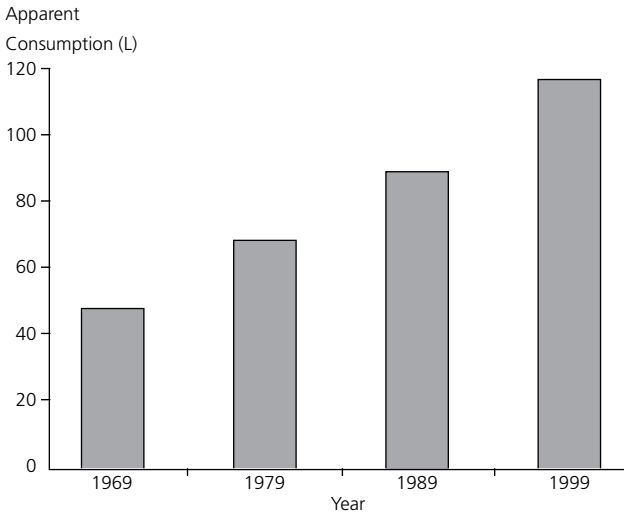
The most recent apparent consumption data (based on supply) in Australia indicate that the per-capita consumption of carbonated and aerated beverages, including sugar-sweetened and artificially sweetened or "diet" drinks, in 1998–99 was 113.0 litres. This equated to an increase of 240 per cent over 30 years (Figure 1) (Australian Bureau of Statistics 1998a). Similarly, the soft drink industry reported that the average per capita consumption of soft drinks was 110 litres in 2003. This amount equates to approximately 300 ml of soft drink (regular and diet) consumed per person, per day (Australian Beverages Council 2007b).

2.2 Beverage Industry Data

Data from the soft drink industry have indicated that the rapid market growth observed over previous years has slowed over the past 5 years. This slower growth has been accompanied by an increase in sales of artificially-sweetened drinks. For example, recent research used industry-based Australian sales figures to analyse purchasing patterns of water-based beverages from 1997–2006 (Levy and Tapsell 2007). During this time, the total volume of sales of all soft drinks (diet and regular) increased by 5 per cent and this increase was mainly due to an increase in sales of diet soft drinks which increased by 28 per cent, with sales of sugar-sweetened soft drinks

remaining relatively stable. The volume share of regular compared to diet soft drinks changed from 76:23 in 1997 to 69:31 in 2006. These trends in sales of the different beverages are observed from other data sources, such as the *Euromonitor Report* on carbonated soft drinks in 2006 (Euromonitor International 2006) and an earlier beverage industry report in Australia (McPherson 2005). Apart from diet soft drinks, other growth areas in water-based beverages in Australia include sports drinks, drink mixers (used with alcoholic drinks) and energy drinks (Levy and Tapsell 2007).

Figure 1: Aerated and carbonated waters consumption in Australia from 1969–99: Apparent consumption data



Source: Australian Bureau of Statistics 1998a

2.3 Dietary Survey Data

2.3.1 1995 National Nutrition Survey

The most recent survey of dietary behaviours, including beverage consumption, at the national level was the 1995 National Nutrition Survey (1995 NNS) (Australian Bureau of Statistics 1998b). The 1995 NNS used a 24-hour recall interview by trained dietitians to estimate the food and drink consumption of a nationally-representative sample of the population aged 2 years and over.

Basic data were published from this survey but food-specific data were not originally published. The NSW Centre for Public Health Nutrition therefore undertook an in-depth analysis of these survey data to provide a detailed picture of consumption patterns in Australia. Amounts of soft drinks consumed, which are reported in grams in the NNS data, have been converted to millilitres in this document to avoid confusion and make them comparable to other reported studies.

2.3.1.1 Consumption among children

Consumption of all sugar-sweetened drinks by children increased with age (Figure 2). Most of this increase was due to soft drink consumption, with similar intakes of cordials, fruit juices and fruit drinks across age groups. For children of all ages (2–18 years), the largest contributor to sugar-sweetened drinks consumption was soft drinks, followed by cordials, fruit juice, fruit drinks and sports drinks. Similarly for adults, the largest contributor to sugar-sweetened drinks was soft drinks, followed by fruit juice, fruit drinks, cordials and sports drinks (Figure 3).

Figure 2: Sugar-sweetened beverage consumption for different age groups of children aged 2–18 years: data from the 1995 National Nutrition Survey; analysis by NSW Centre for Public Health Nutrition

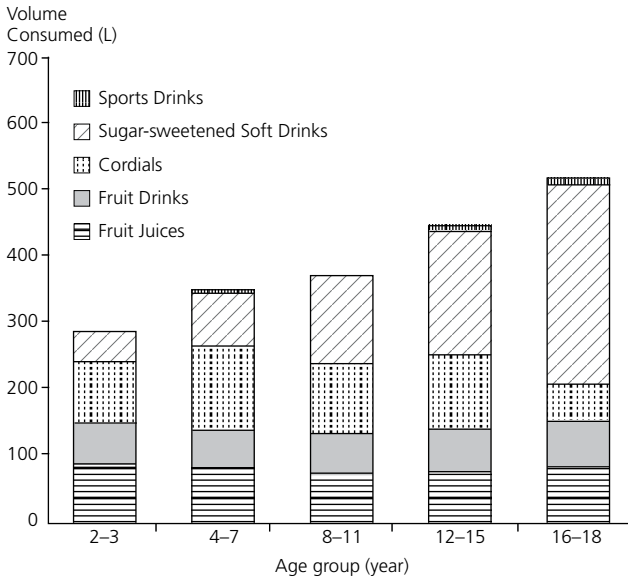
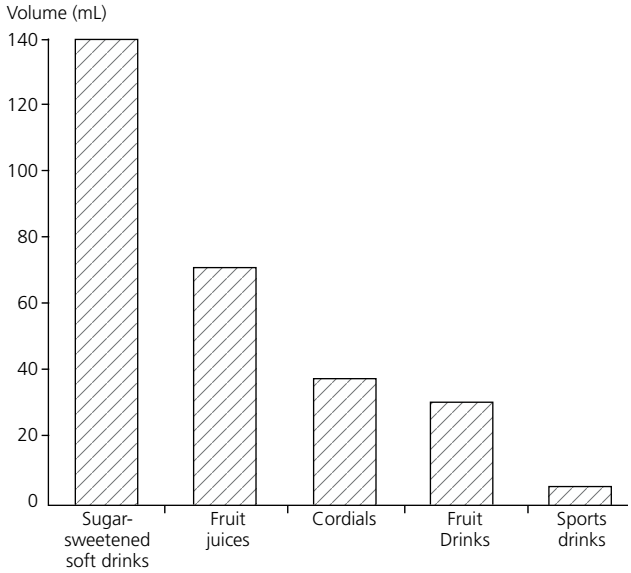
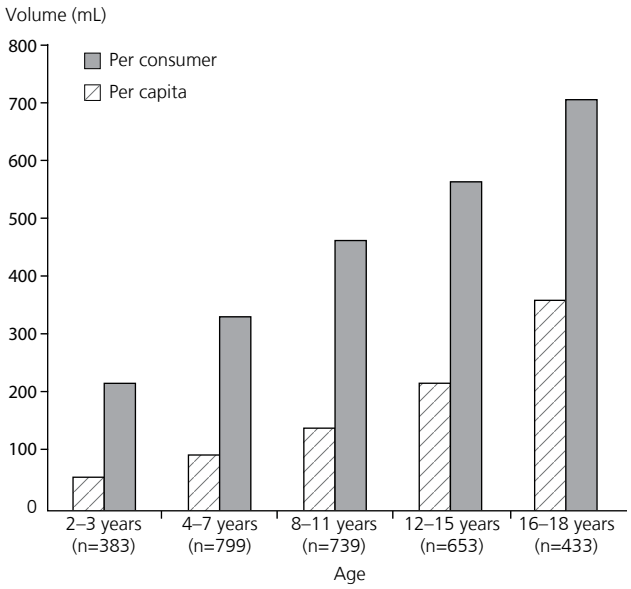


Figure 3: Consumption of different sugar-sweetened beverages among adults, per capita per day, in 1995; data from the 1995 National Nutrition Survey; analysis by NSW Centre for Public Health Nutrition



On the survey day, soft drinks were consumed by approximately a quarter of 2–7 year olds, a third of 8–15 year olds and half of 16–18 year olds. Per-capita intake increased with age among children, from 53 ml for 2–3 year olds to 364 ml for 16–18 year olds. Also, per-consumer intake (the average intake among those who consumed soft drinks) increased with age, ranging from 222 ml (approximately two thirds of a can) for 2–3 year olds to 714 ml (approximately 2 cans) for 16–18 year olds (Figure 2). Until 12 years of age, boys and girls consumed similar amounts of soft drinks but after this age consumption in males surpassed that of females. For example the average per-capita consumption among boys aged 16–18 years was double that consumed by girls, an average of 480 ml compared to 240 ml per day. Among those consuming soft drinks, intakes were 836 ml for boys and 545 ml for girls, representing 10.8 per cent of total energy intake for boys and girls in this age group.

Figure 4: Amounts of sugar-sweetened soft drinks consumed among children aged 2–18 years by different age groups, data from the 1995 National Nutrition Survey; analysis by the NSW Centre for Public Health Nutrition



2.3.1.2 Consumption among Adults

Among adults, the highest consumers of soft drinks were young adult males, aged 19–24 years, with 58 per cent consuming an average of 800 ml per day. The next highest consumers were males aged 25–44 years, with 34 per cent consuming an average of 642 ml, and females aged 19–24 years, with 36 per cent consuming an average of 562 ml. The "percentage consuming" and "amounts consumed" decreased with increasing age among adult males and females (Figure 5).

2.3.1.3 Consumption by State, Region and Socio-economic Status

Socio-economic status

Socio-economic status (SES), SEIFA (Australian Bureau of Statistics Socio-Economic Indexes for Areas) and current occupation were identified as being associated with soft drink consumption among adults in the 1995 NNS. Consumption of soft drinks was significantly higher among those in the quintile of highest socio-economic disadvantage compared to those in the quintile of lowest socio-economic disadvantage — 161 ml compared with 117 ml per capita respectively. Socio-economic status was not associated with soft drink consumption among children. Having a non-professional occupation was associated with higher consumption of sugar-sweetened soft drinks compared to having a managerial or professional occupation — 192 ml compared with 108 ml per capita respectively.

State/Territory

Lowest per capita intake was in the Australian Capital Territory for children (138 ml), and Tasmania for adults (90 ml). Highest per capita intake was in South Australia for children (228 ml) and the Northern Territory for adults (177 ml).

Region

There were no significant differences in soft drink consumption patterns between people living in urban areas compared to those living in rural/remote areas.

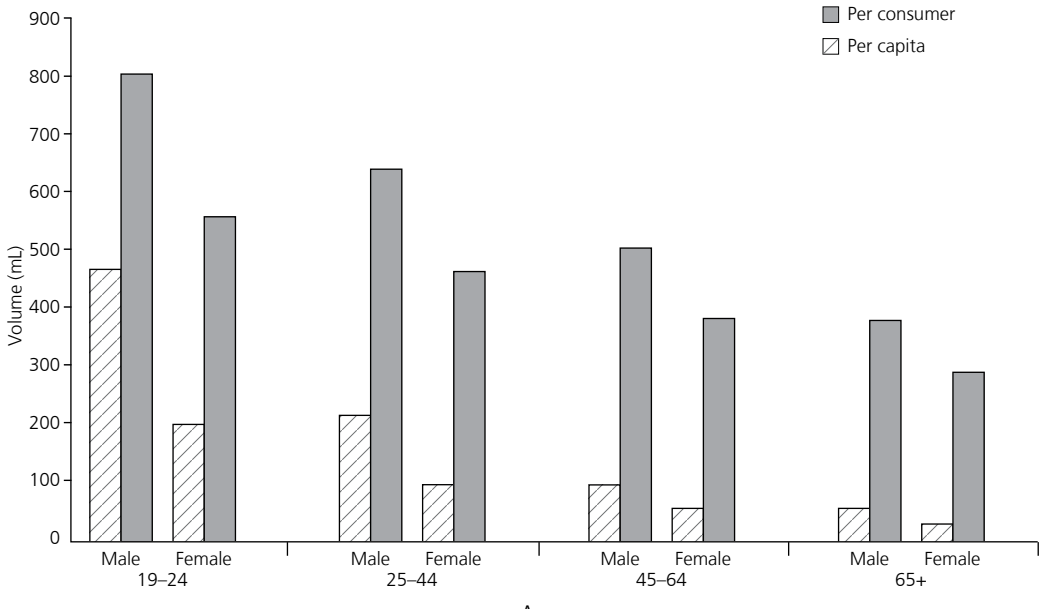
2.3.2 Other Dietary Surveys in Australia

2.3.2.1 NSW Population Health Survey

The most recent report on Child Health from the NSW Population Health Survey, using short questions to assess dietary behaviours, indicates that half of children aged 2–8 years and three quarters of children aged 9–15 years consumed sugary drinks (soft drinks, cordials or sports drinks) weekly. Twenty per cent of 9–15 year olds reported regularly consuming more than 1.5 cups of sugary drinks per day (Centre for Epidemiology and Research 2008).

An earlier survey (2001), using the same questions but stratified by different age and frequency categories, found that over one quarter of children aged 2–4 years were reported to drink at least one cup of sugary drinks per day, with 13 per cent reported to drink two or more cups per day. Children aged 5–12 years consumed more of these drinks, with 42 per cent reported to consume one or more cups per day, and half of these reported to drink two or more cups per day (Centre for Epidemiology

Figure 5: Volume of sugar-sweetened soft drinks consumed among adults in Australia, by age and sex; data from the 1995 National Nutrition Survey; analysis by NSW Centre for Public Health Nutrition



and Research and NSW Department of Health 2002).

2.3.2.1 FSANZ Survey

A phone survey conducted for the *Food Standards Australia New Zealand* (FSANZ) in 2003 to determine the intake of intense sweeteners in Australia and New Zealand, showed high consumption of soft drinks by Australian adolescents (12–17 years) and young adults (18–24 years) (Food Standards Australia New Zealand 2003a). Over three-quarters of 12–24 year olds reported consuming soft drinks in the previous seven days, with males more likely to be consumers than females.

2.3.2.2 Schools Physical Activity and Nutrition Survey

In a recent state-wide survey, the Schools Physical Activity and Nutrition Survey (SPANS), schoolchildren in Years 6 to 10 in New South Wales were asked about their usual intake of soft drinks using a short dietary question (Booth et al. 2006). Approximately 55 per cent of boys and 40 per cent of girls reported drinking more than 250 ml of soft drink per day (defined as all types of soft drink including fruit flavoured drinks and sport drinks but excluding fruit juice); with 25–30 per cent of boys and 10–20 per cent of girls drinking at least 400 ml per day. Of these, about 10 per cent of boys and 5 per cent of girls consumed more than 1 litre per day.

2.3.2.3 Childhood Asthma Prevention Study

Several studies internationally have shown that soft drinks are consumed in surprisingly large amounts by toddlers, but data are lacking for this age group in Australia. A study of food intake in toddlers in Western Sydney as part of the Childhood Asthma Prevention Study (CAPS) found that sugary beverages (excluding fruit juice) contributed substantially to energy and carbohydrate intakes (Webb et al. 2006). On average, soft drinks were consumed on alternate days by 29 per cent of the children aged 16–24 months.

Section 3

Factors Associated with Soft Drink Consumption

The majority of research examining factors affecting soft drink consumption, albeit somewhat limited, has been carried out among children, and among adolescents in particular. Consequently they are the main focus of this section. Adolescence is a time when children have more autonomy over food and drink choices, both within and away from school. There is a lack of information about the barriers to limiting or reducing soft drink consumption and about attitudes and beliefs concerning soft drink consumption among other subgroups of the population.

3.1 Socio-Cultural Factors

3.1.1 Socio-Economic Status and Maternal Education

The 1995 National Nutrition Survey data only showed differences in soft drink consumption among different levels of socio-economic disadvantage for adults (section 2.3). However two Australian studies (Booth et al. 2006; Scully et al. 2007) showed that a higher intake of soft drinks was associated with lower socio-economic status (SES) in school students. A study in Victoria found that SES, measured using maternal education, was associated with the availability of sugary drinks at home; a higher proportion of adolescents of low SES reported that soft drinks, sports and energy drinks were always or usually available at home (MacFarlane et al. 2007).

The WHO collaborative cross-national study of *Health Behaviours among School-aged Children 2001–02* (Vereecken et al. 2005b) showed a relationship between lower SES, as determined by family affluence, and higher soft drink consumption, across many European countries. However among countries still in socio-economic transition, i.e. countries in Central and Eastern European countries, soft drinks were considered luxury items and consumed more by affluent families. This study also showed that consumption of soft drinks is not only influenced by the SES of individual children but also by the SES of the school population. That is, it may be more difficult to consume soft drinks in an environment where other pupils are not stimulated or are less stimulated to do so.

Mother's educational level is associated with soft drink consumption (Vereecken et al. 2004) but this association was not completely explained by the mother's consumption and other food parenting practices, which is the case with fruit and vegetable consumption in children. Soft drink consumption in 18-month-old children in the UK was associated with lower educational level of mothers (Northstone et al. 2002).

The Food Standards Australia New Zealand (FSANZ) phone survey of adolescents and young adults found that, among young adults, the highest consumers of sugar-sweetened soft drinks were those with a lower annual income, with no tertiary level education, and those with either no occupation or an unskilled occupation (Food Standards Australia New Zealand 2003a).

A study in The Netherlands showed that adolescents planning to go to college or university had lower odds of consuming soft drinks (Bere et al. 2007), although this factor became less significant when psychosocial variables such as accessibility, modelling and attitudes were introduced into the model.

3.1.2 Cultural Background

The FSANZ phone survey of adolescents and young adults in Australia found that Aboriginal and Torres Strait Islanders were more likely to consume sugar-sweetened soft drinks compared to other Australians (72 per cent versus 50 per cent) and consumed significantly larger amounts (249 ml versus 128 ml per day) (Food Standards Australia New Zealand 2003a). The 2004 SPANS survey of children in Years 6–10 in NSW found consumption of soft drinks to be lowest among students of Asian background and highest among boys of Southern European and Middle Eastern background (Booth et al. 2006).

3.1.3 Gender

Fewer girls than boys consume soft drink in Australia, and among those that do, girls consume smaller amounts of soft drink than boys (section 2.2). This gender effect has been observed in Europe also. For example, the large WHO collaborative cross-national study of *Health Behaviours among School-aged Children 2001–02* showed that girls generally

consume less soft drink than boys (Vereecken et al. 2005b).

At least some of the factors affecting soft drink consumption in boys appear to have no effect in girls. A study of adolescents in Belgium found that none of the psycho-social or family-related factors were associated with soft drink consumption in girls (Haerens et al. 2007). Similarly, earlier studies in the US have noted that, although many of the same predictors for soft drink consumption were found in girls as boys (Kassem et al. 2003; Kassem and Lee 2004), girls with negative attitudes towards drinking regular soft drinks were more likely to believe that they would gain weight and have too much caffeine thus they tended to avoid it. Nevertheless, the average female student moderately believed that regular soft drinks tended to make them gain weight and strongly believed it was important not to gain weight, yet the majority drank regular soft drinks regularly (Kassem et al. 2003). This study was aimed particularly at examining the attitudes towards dental health. Although students strongly understood and believed the messages concerning soft drinks and tooth decay, they did not change their behaviour accordingly.

3.2 Psycho-Social Factors

3.2.1 Personal Factors

Personal factors appear to moderate the relationship between environmental factors and behaviour. In Norway, personal preferences, i.e. taste, was the number one determinant of soft drink consumption, and attitude was the fourth most important determinant of soft drink consumption in adolescents, with the environmental factors of accessibility and modelling (consumption behaviour of significant others) in between (Bere et al. 2007). Soft drink consumption in school-aged children has been notably correlated with taste preferences in other studies (Grimm et al. 2004). In one study of 8–13 year olds in the US, those who reported the strongest taste preference were 4.5 times more likely to consume soft drinks five or more times per week compared with those with a lower taste preference. A focus group study with groups of children aged 8–9 years and 13–14 years showed that younger children prefer the taste of still, fruit-flavoured drinks and adolescents prefer the taste of carbonated drinks (May and Waterhouse 2003).

Attitude and subjective norm (perception of other people's views and attitudes towards soft drink consumption), together with perceived behavioural control, explained 60 per cent of the variance in intention to drink regular soft drinks in 13–18 year olds in the US (Kassem et al. 2003; Kassem and Lee 2004). However, taste enjoyment was one of the most predictive expected outcome beliefs of regular soft drink consumption. In these studies, quenching of thirst was the second most important predictor of attitude, after taste, towards drinking soft drinks — yet soft drinks have been found to be poor at quenching thirst when compared to water (Rolls et al. 1990; Brouns et al. 1998).

Parents and friends have been identified as being more influential than peers in the consumption patterns of younger children aged 8–9 years in the UK (May and Waterhouse 2003), although peer groups are considered to play a greater role in adolescence (Buchanan and Coulson 2006). Cost, availability and thirst were more important in older children aged 13–4 years. In the NSW Schools Physical Activity and Nutrition Survey 2004 (SPANS) of children aged 5–16 years, peer influences were not particularly apparent in soft drinks attitudes and intended consumption (Booth et al. 2006). Adolescents who perceived more social pressure to limit soft drink consumption were found to be more likely to consume more in the Study on Medical Information and Lifestyle in Eindhoven (SMILE) study in The Netherlands (de Bruijn et al. 2007).

The SMILE study also showed that moderate "agreeableness" (a measure of adolescents" willingness to comply with parental practices and rules) of adolescents is associated with less soft drink consumption, however, those that were most "agreeable" consumed a lot (de Bruijn et al. 2007). This was attributed to pressures outside of the home environment — pro-social motives where those most agreeable wanted to "fit in". It is postulated that the more agreeable adolescents were more inclined to live up to expectations raised by prototype-based advertisements and marketing.

One of the few studies examining the factors affecting soft drink consumption in adults showed that consumption of sugar-sweetened soft drinks was associated with less restrained and more external eating, i.e. sensitive to external stimuli such as taste (Elfhag et al. 2007). The study, conducted among 3265 adults in Sweden showed that, in contrast, diet soft drinks were consumed by persons with a higher body mass index (BMI) (possibly in an attempt to reduce their weight), more restrained eating and more emotional eating.

3.2.2 Parenting Practices

Parents as Models

A study in Australia showed that the influence of mothers, either as models of eating behaviours or as the providers of food, is pervasive (Campbell et al. 2007). Parental soft drink consumption was positively associated with younger

children's intake in two studies (Grimm et al. 2004; Vereecken et al. 2004). Mother's consumption was found to be an independent predictor for regular soft drink consumption among children in Belgium (Vereecken et al. 2004). In the US, children aged 8–13 years whose parents regularly drank soft drinks were nearly three times more likely to consume soft drinks five or more times per week compared with those whose parents did not regularly drink soft drinks (Grimm et al. 2004).

A higher frequency of preparing food was found to be related to lower intakes of carbonated beverages among female adolescents in the US (Larson et al. 2006).

Parenting Styles

Less restrictive parenting practices are associated with a higher consumption of healthier food options such as fruit and vegetables in children; however the evidence is not as equivocal for soft drinks. Indeed, the converse has been found in some recent studies. For example, van der Horst et al found that in The Netherlands less restrictive parenting practices, relating to specific behaviours such as "food rules", were associated with higher consumption of sugar-sweetened beverages among 383 adolescents (van der Horst et al. 2007). This association was independent of perceived parenting practices by the adolescents, and was mediated by attitude, self-efficacy and modelling from parents (parental consumption). The association was strongest among adolescents who perceived their parents as being moderately strict and highly involved. These authors concluded that parents should be involved in interventions aimed at changing dietary behaviours including soft drink consumption and that interventions aimed at the promotion of healthy parenting practices are best tailored to the general parenting style of the participants (for example, strict and/or involved). More restrictive parenting practices were also found to be associated with less soft drink consumption (De Bourdeaudhuij and Van Oost 2000) and stricter parenting practices were found to be associated with less soft drink consumption in a recent study in The Netherlands (de Bruijn et al. 2007).

However, findings from studies among younger children suggest that strict parental practices can in fact increase children's preferences for, and intake of, the restricted foods. These different findings may relate to differences in the type of practices used between age groups. For example, parents of younger children might use pressure to get their children to eat more or may restrict access to certain foods. For adolescents, parents might use clearly defined rules about the times when a certain food can be eaten and how much of a certain food they can eat.

Buchanan and Coulson considered that the role of parents' influence and control in adolescents' patterns of soft drink consumption remains unclear and warrants further investigation (Buchanan and Coulson 2006).

3.3 Environmental Factors

3.3.1 Soft Drink Availability

Availability at School

Increased soft drink consumption has been related to the availability of soft drinks in vending machines in the school environment in a number of studies. However, it appears that when soft drinks are ubiquitous in schools the link between consumption and availability is less discernible (French et al. 2003; Grimm et al. 2004; Vereecken et al. 2005a). Access to vending machines selling soft drinks in schools in the US was not related to consumption in either boys or girls (Kassem et al. 2003; Kassem and Lee 2004). In Norway, most soft drink consumption occurs outside of school despite soft drinks currently still being available in schools (Bere et al. 2007). Vending machines were not available in schools involved in a study of adolescent soft drink consumption in the UK (Buchanan and Coulson 2006); and this study found that consumption of soft drinks was higher at the weekends.

Nevertheless, the availability of soft drinks at school, either in the school canteen or in vending machines, may send messages to children that they are suitable drinks; also their easy availability at schools negates the need to provide water. The sale of foods and drinks at schools is likely to have a ripple effect in the community (Bell and Swinburn 2005), thus banning soft drinks at schools conveys a healthy message to children and this message has the potential to affect community attitudes. In recent years four Australian state governments (New South Wales, Victoria, South Australia and Western Australia) have accordingly imposed a ban on the sale of soft drinks and other sugar-sweetened drinks by canteens in public schools (Bell and Swinburn 2005). In NSW this ban on sugar-sweetened drinks is part of *Fresh Tastes @ School,* the NSW Healthy School Canteen Strategy. Sugar-sweetened drinks with more than 300 kJ per serve or more than 100 mg of sodium per serve have not been allowed in school canteens and vending machines in NSW since Term 1, 2007 (NSW Department of Health and NSW Department of Education & Training 2006). These drinks include: soft drinks, energy drinks, fruit drinks, flavoured mineral waters, sports drinks, cordials, iced teas, sweetened waters, sports waters, and flavoured crushed ice drinks. In Victoria the ban extends to high-energy, high-sugar soft drinks brought in to school.

Availability at Home

A number of studies have highlighted that the amount and diversity of soft drinks available and accessible at home is important (French et al. 2003; Grimm et al. 2004). Haerens et al recently showed that adolescent boys in Belgium who had more unhealthy food products available at home consumed more soft drinks than those who had fewer unhealthy food products available at home. However this relationship was not observed in girls (Haerens et al. 2007). Home availability was found to be an important predictor of soft drink consumption in 8–13 year olds in a study in the US (Grimm et al. 2004). Another study with adolescent boys and girls in the US showed that availability of regular soft drinks at home was the strongest predictor of being able to control intake (Kassem and Lee 2004).

Availability in the wider environment

Few studies link the wider availability of soft drinks to consumption; however, a study of food intake patterns among adolescents in Victoria found that those living in metropolitan areas had a higher frequency of sugar-sweetened soft drink intake compared to those living in non-metropolitan areas (Savige et al. 2007). The authors attributed this difference, in part, to the accessibility and availability of these foods with a higher proportion of adolescents in the metropolitan area living near a fast food outlet.

3.3.2 Portion Size

The beverage industry has steadily increased container sizes over the last 50 years. In the 1950s the standard serving size was a 200 ml bottle, which increased to a 375 ml can, which was superseded by a 600 ml bottle. Studies have shown that the larger the container, the more people are likely to drink, especially when they assume they are buying single-serve size containers. For example, Flood et al have shown that increasing beverage portion size from 350 ml to 530 ml significantly increased the weight of beverage consumed regardless of beverage type — in this case regular cola, diet cola or water (Flood et al. 2006). As a consequence, energy intake increased 10 per cent for women and 26 per cent for men when there was a 50 per cent increase in the portion of regular cola served. Food intake did not differ under the controlled conditions; thus overall energy intake was increased as a result of the extra energy from the larger beverage intake. Most recently, a study showed that increasing portion sizes of all foods and beverages consumed by study participants by 50 per cent of baseline increased energy intake from all food and beverage categories, except fruit as a snack and vegetables, for an 11-day period (Rolls et al. 2007). The amount of beverage consumed increased from about 470 ml in both women and men to 557 ml in women and 630 ml in men.

Disproportionate pricing practices also encourage people to drink large servings as these often cost just a fraction more than the smaller servings (Young and Nestle 2002).

Large serve sizes contribute to an "obesogenic" environment, as they facilitate excess consumption of energy (Dietary Guidelines Advisory Committee 2005). Dietary guidelines and public campaigns have highlighted the importance of portion size as a central concept related to energy intake (Matthiessen et al. 2003).

3.3.3 Cost

In a number of papers, Drewnoswki and co-workers purport that the main issue in relation to nutrient-poor foods and beverages and obesity is the cost; that is, nutrient-dense diets are more costly than nutrient-poor, energy-dense foods which are relatively cheap. Drewnowski and Bellisle (2007) conclude that the obesity-promoting capacity of different beverages is linked not so much by their sugar content but by their low price, although these researchers concur that taste is likely to be the main factor affecting the obesity-promoting capacity of soft drinks (Refer to Section 3.1).

Cost was reported as being an important determinant of carbonated soft drink consumption, as opposed to fruit juice and still fruit drinks, in children aged 13–14 years in a study in the UK (Buchanan and Coulson 2006). Availability and thirst were also recognised as important determinants, although foremost was taste.

3.3.4 Marketing

Soft drink companies use a wide variety of marketing techniques to increase sales. These techniques include easy accessibility in a wide variety of venues, heavy media advertising, sponsorships of concerts and professional organisations, targeting of schools (e.g. through vending machines), tie-ins with movies and music groups, and merchandise (Jacobson 2005). Pre-teens and young adults are particularly vulnerable to forceful advertising, with peer group pressure playing an additional role (Grimm et al. 2004).

The marketing of unhealthy foods, including soft drinks, to children is recognised as a probable contributory factor in childhood obesity and subsequently is the subject of much political and public debate. As Nestle suggested "food companies view schoolchildren as an attractive market and use every possible means to promote their products to this young, impressionable, and captive audience" (Nestle 2000). She also provided 23 examples

of how soft drink companies market their products to children in and outside schools (Nestle 2000). A recent study in Australia has shown that soft drinks are the food products most commonly advertised around primary schools, comprising about one-quarter of all food advertisements (Kelley et al. 2008).

The ethics of marketing unhealthy foods and soft drinks to children has been highlighted (Mehta 2007). Over and above the direct effect of marketing on brand recognition and purchasing behaviour (by self or requests to parents i.e. "pester power"), Mehta considers that marketing leads to development of consumerist values, acquisitiveness, dissatisfaction and unhappiness.

Soft drink manufacturers in Australia have recently introduced polices which state their intention not to market their products directly to young children. However, indirect marketing (e.g. through product placement, marketing through websites and promotions, and exposure to marketing directed at older children and adults) may undermine the impact of this commitment.

Among adolescents in the US, the reported second most important factor affecting their ability to control their behaviour was "seeing advertisements to encourage drinking soft drinks" (Kassem and Lee 2004).

Marketing communications may have a disproportionate effect on people who consume unhealthy products frequently, i.e. those who consume unhealthy food products most are those who are most receptive to advertisements (Hoek 2005).

Exposure to TV advertising

Television is a medium through which children are commonly exposed to food marketing. Food marketers advertise heavily during children's programming in Australia (Hastings et al. 2007; Kelly et al. 2007), and soft drink is consistently featured near the top of the list of advertised food items in different countries, including Australia (Kotz and Story 1994; Lemos 2004).

Increased soft drink consumption has been related to TV exposure in a number of studies (Grimm et al. 2004; van den Bulck and van Mierlo 2004; Utter et al. 2006). The relationship was observed for adolescent boys only — not girls — in a recent study of children in grades 7–8 in Belgium (Haerens et al. 2007). A study of children aged 5–6 years and 10–12 years in Melbourne showed that children who watched TV for more than 2 hours per day were 2.3 times more likely to consume ≥ 1 serve/day of high-energy drinks than children who watched less than or equal to 2 hours of TV per day (Salmon et al. 2006).

The NSW Schools Physical Activity and Nutrition Survey, 2004, examined influences over soft drink consumption in boys and girls in years 6, 8, and 10. This survey showed that boys and girls disagreed with statements that they were influenced to buy soft drinks as a result of advertisements. The majority of children reported that they did not purchase the drinks with the best advertisements nor were they influenced by competitions or prizes in their choice of soft drinks, although a large proportion neither agreed nor disagreed with these statements (Booth et al. 2006).

Product Placement

Marketing occurs in a subliminal way via product placements in TV programs and movies. According to Greer, when a product is embedded in the content of a movie of show, it can carry increased credibility with the target audience (Greer 2003). A content analysis of popular American movies has shown that branded soft drinks are often prominently positioned in movies (Cassady et al. 2006). This study showed that branded soft drinks appeared more commonly than other branded non-alcoholic beverages, branded beer and other branded alcoholic beverages. Actors consumed soft drinks in five times the number of movies compared to their consumption of other non-alcoholic beverages (such as water, tea, coffee or milk).

Sponsorship and promotion of sport

Soft drinks, which increasingly include sports drinks, are frequently promoted through association with sports teams and clubs at the national, state, and local levels. A recent analysis of sports sponsorship in New Zealand showed that, at the junior level the largest share (a quarter) was for the advertisement of unhealthy foods, including soft drinks, with only three per cent promoting healthy foods (Maher et al. 2006). The sponsorship listings included those that specifically mentioned sponsorship for junior clubs, junior teams, or school-aged tournaments.

Section 4

Costs and Health Implications on Soft Drink Consumption

4.1 Weight Status

4.1.1 Evidence of an Association

The 2003 World Health Organization (WHO) report *Diet, Nutrition and the Prevention of Chronic Diseases* classified the scientific evidence on the association between sugary drinks consumption and increased risk of obesity as probable (Joint WHO/FAO Expert Consultation 2003). Since this report there has been substantial debate about the strength of the relationship between the consumption of sugary drinks and obesity. A recent review concluded that the evidence on this topic remains equivocal and that unsatisfactory methodological rigour in many of the experimental and prospective studies makes it difficult to draw firm conclusions (Pereira 2006). The limitations of these studies, many of them cross-sectional, have also been recently highlighted by other researchers (Drewnowski and Bellisle 2007). However, the majority of systematic reviews and meta-analyses support the view that sugary drinks, particularly soft drinks, have a causative role in obesity (Taylor et al. 2005; Malik et al. 2006; Vartanian et al. 2007).

The type of sugar used to sweeten soft drinks has been raised as an issue by some researchers. In America, where many of the studies have been carried out, soft drinks are sweetened using high-fructose corn syrup (HFCS). HFCS consists of a slightly higher ratio of fructose to glucose than sucrose — the sugar used to sweeten soft drinks in Australia — does, and the molecules are separated, compared to the disaccharide sucrose. HFCS in soft drinks has been particularly implicated in contributing to the obesity epidemic (Bray et al. 2004). However the idea that HFCS acts any differently to sucrose in soft drinks in terms of weight gain has been heavily disputed and experimental and clinical studies show that any added sugars in soft drinks are likely to contribute equally to an energy imbalance (Anderson 2007; Forshee et al. 2007; Monsivais et al. 2007).

The findings of the strength of the evidence from the studies included in the most recent systematic reviews are summarised in Table 2. In total, 26 out of 42 studies showed a significant positive association between the consumption of sugary drinks (mainly soft drinks) and unhealthy weight gain, and no studies showed a negative association. As the methodological strength or power of the studies increases, i.e. from cross-sectional to prospective through to experimental, the proportion of studies showing a positive association between sugary drinks and weight increases, as does the strength of effect.

The earlier review by Taylor et al (2005) examined the impact of sugary drinks on body weight in children and concluded that "overall there is extensive evidence that sugary drinks contribute to unhealthy weight gain in children".

Table 2: Number of studies linking sugary drinks, particularly soft drinks, to obesity (sourced from Taylor et al. 2005, Malik et al 2006, Vartanian et al 2007)

Increasing strength of evidence →

Association	Cross-sectional studies	Prospective studies	Experimental (E)/ Intervention (I) studies	Total number of studies
Positive ($p < 0.05$)	13	8	3 E / 2I	26
None/not-significant ($p > 0.05$)	12	4	0	16
Negative ($p < 0.05$)	0	0	0	0

Subsequently the systematic review by Malik et al examined publications from 1966 to May 2005 on the relationship between sugar-sweetened beverages and risk of weight gain in children and adults. Thirty publications were selected — 15 cross-sectional, 10 prospective and 5 experimental — based on relevance and quality of design and methods. These authors concluded that the weight of epidemiological and experimental evidence indicates that a greater consumption of sugar-sweetened soft drinks is associated with weight gain and obesity; and that sufficient evidence exists for the need for public health strategies to reduce sugary drinks consumption, particularly in children and adolescents (Malik et al. 2006).

The most recently published systematic review and meta-analysis separated out studies that examined the association between soft drink consumption (sugared soda — equivalent to sugar-sweetened soft drinks) and energy intake from those studies that examined the relationship between soft drink consumption and body weight (Vartanian et al 2007). As expected, the findings showed a weaker relationship between soft drink consumption and body weight than with total energy consumption, as soft drinks are not the only source of energy in the diet. Nevertheless, although cross-sectional studies and longitudinal studies showed only small positive associations between soft drink consumption and BMI ($r = 0.05$ and 0.09 respectively), a moderate association was observed for experimental studies that controlled for many extraneous variables ($r = 0.24$). Also, 10 of 12 cross-sectional studies, five of five longitudinal studies and all four long-term experimental studies examined showed that energy intake rises when soft drink consumption increases. The effect sizes for these studies, respectively, were 0.13, 0.24 and 0.30. The evidence also supports the independent contribution of soft drinks to a higher energy consumption overall. The authors of this extensive review concluded that "recommendations to reduce population soft drink consumption are strongly supported by the available evidence" (Vartanian et al. 2007).

The longitudinal studies showing a positive association between sugary drinks and weight status are detailed in Table 3. The association between soft drink consumption and BMI was particularly noted from two studies involving very large sample sizes, one in children (Berkey et al. 2004) and one in women (Schulze et al. 2004). Two studies showing an association between sugar-sweetened beverages and weight status were conducted after the systematic reviews (Dhingra et al. 2007; Dubois et al. 2007). An unusual finding of the latter study, which was part of the Framingham Heart Study, was that the relationship for soft drink consumption was seen for diet as well as regular soft drinks (Section 5.2).

The potential contributions of sugar-sweetened beverages to weight gain are supported by the results of three small clinical trials in adults. Two of these short-term trials, one in the US and one in Denmark, found that those adults who consumed large amounts of sugar-sweetened drinks gained weight while those consuming artificially-sweetened drinks lost weight (Tordoff and Alleva 1990; Raben et al. 2002). The other short-term trial, conducted in the US, compared the effect of consumption of sugar in liquid form (soft drink) and as jelly beans, on dietary compensation, i.e. energy intake from other food and beverages, and BMI (DiMeglio and Mattes 2000). Body weight and BMI increased significantly during consumption of the sugary fluid only.

There have been two controlled intervention trials that have examined the effect of soft drink reduction on weight status in children. One intervention trial showed that a decrease in soft drink consumption led to a decrease in BMI but this effect was only observed for subjects in the upper tertile for baseline BMI (Ebbeling et al. 2006). The intervention study — the Beverages and Student Health (BASH) study — involved the home delivery of bottled water and other non-caloric beverages (diet soft drinks) to 103, 13–18 year old students who regularly consumed at least one 360 ml serve of soft drink per day, in the US. The 25-week study also involved written educational information and telephone counselling. Post-intervention, energy intake from caloric beverages had reduced significantly, by 82 per cent in the intervention group compared to no change in the control group. Some of the success of this intervention among the most overweight children may stem from the inclusion of only relatively high consumers of soft drink in the study.

Another intervention study "CHOPPS" (Christchurch Obesity Prevention Project in Schools) aimed to reduce all carbonated drinks (sweetened and unsweetened) as a means of preventing inappropriate weight gain in school children aged 7–11 years in the UK (James et al. 2004). This school-based educational program achieved a significant difference in BMI between intervention and control students of 7.7 per cent after 12 months of intervention, mainly due to an increase in BMI in the control group. However, this difference in BMI could not be directly attributed to a reduction in sweetened soft drink consumption in the intervention group as no significant difference in consumption of these drinks was observed (French et al. 2004). Other limitations of this study include that there was low intensity of intervention and that intakes were self-reported by each child. Effects

Table 3: Longitudinal studies showing a positive relationship between sugary drinks consumption and weight status in children, adolescents and adults (chronological order)

Reference	Study population	Duration of follow-up	Types of beverages investigated	Findings
Children				
Ludwig et al. 2001	548 middle-school children, aged 11–12 years, from Boston, USA	19 months	Sugar-sweetened beverages (regular soft drinks, fruit drinks, iced teas)	Baseline sugar-sweetened drink consumption ($p< 0.02$) and change in consumption ($p< 0.03$) positively associated with change in BMI; change in consumption associated with incident obesity ($p < 0.02$). Each additional serve of soft drink/day = increase in BMI of 0.24. OR increased by 60% .
Berkey et al. 2004	11,654 children, aged 9–14 years, from 50 states in the USA	Two × one-year periods	Sugar-added beverages (regular soft drinks, fruit drinks, iced teas)	Consumption of sugar-added beverages was associated with small BMI gains during the corresponding year (boys $p < 0.05$; girls $p < 0.1$).Children who increased intakes by 2 or more servings/d from the prior year gained weight (boys $p < 0.05$; girls $p < 0.05$). Adjustments for energy intake attenuated the association.
Phillips et al. 2004	132 girls, aged 8–12 years, from Massachusetts, USA	10 years	Sugar-sweetened soft drinks	Energy from regular soft drinks related to higher BMI z-score ($p < 0.001$) but not to % body fat. Girls in the third and fourth quartiles of higher intake had BMI z-scores that were 0.17 units higher than subjects in the first quartile (lowest intake)
Welsh et al. 2005	10,904 children aged 2–3 years, from Missouri, USA	1 year	Sweet drinks (soft drinks, fruit drinks, fruit juice)	Overweight children (at baseline) who drank at least one serving of soft drink or fruit drinks per day had approximately twice the risk of overweight at follow-up compared to overweight children who consumed less than 1 serving per day.
Striegel-Moore et al. 2006	2371 girls, aged 9–10 years, from 3 states in USA	10 years	Sugar-sweetened soft drinks (from 3-day food dairy) Also examined diet carbonated drinks, coffee/tea, fruit juice, fruit drinks	Positive relationship between increase in regular soft drink consumption and increase in BMI ($p < 0.05$) after adjusting for energy intake (0.01 unit of BMI per 100g soft drink). No relationship between intake of other beverages and BMI
Tam et al. 2006)	281 children, aged 7–8 years, from Western Sydney, Australia	5 years	Sugar-sweetened soft drinks and cordials	Intake of soft drink/cordial was higher in children who were overweight/obese at follow-up compared to those who had an acceptable BMI at both baseline and follow-up ($p = 0.002$)
[1]Dubois et al. 2007	1944 children aged 2.5 years at baseline	2 years	Sugar-sweetened beverages (regular soft drinks and fruit drinks, not juice)	Sugar-sweetened beverage consumption between meals more than doubled the odds of being overweight (multivariate analysis). Children from families with insufficient income who consumed sugar-sweetened beverages regularly between ages 2.5 and 4.5 years were more than 3 times more likely to be overweight at age 4.5 years compared to non-consuming children from sufficient households.
Adults				
Schulze et al. 2004	51 603 females (baseline age 24-44 years); Nurses Health Study II	8 years	Sugar-sweetened soft drinks (also examined diet soft drinks and fruit juice)	For two time periods, women who increased their consumption of sugar-sweetened soft drinks from low to high had significantly larger increases in weight (multivariate-adjusted means, 4.69 kg during 1991–95 and 4.20 kg during 1995–99) and BMI (multivariate adjusted means, 1.72 during 1991–95 and 1.53 during 1995–99) than women who maintained a low or a high intake or substantially reduced their intake ($p = 0.001$).

Reference	Study population	Duration of follow-up	Types of beverages investigated	Findings
Bes-Rastrollo et al. 2006	7194 adults; mean age 41 years	28.5 months (median)	Sugar-sweetened soft drink (also examined diet soft drinks, milk)	In the participants who had gained > or =3 kg in the 5 y before baseline, the adjusted odds ratio of subsequent weight gain for the fifth quintile compared with the first quintile of sugar-sweetened soft drink consumption was 1.6 (95% CI: 1.2, 2.1; p for trend = 0.02).
[1]Dhingra et al. 2007	6039 adults; mean age 52.9 years; Framingham Heart Study	4 years (mean)	Regular (sugar-sweetened) versus diet soft drinks	Consumption of ≥ 1 soft drink/day associated with increased odds of obesity (OR 1.31, 95% CI 1.02,1.68). [NB: same effect sugar-sweetened and/or diet soft drinks]

[1] Study published since most recent systematic review (Vartanian et al. 2007).

might also have been limited due to the cohort having low baseline soft drink intakes.

4.1.2 Evidence of Causality

Although there is some evidence of a link between soft drink consumption and weight status from a large number of cross-sectional studies, such studies do not infer causality by themselves. Indeed, it could be interpreted that high consumption of soft drinks is a marker for poorer dietary habits overall and that it is not the soft drinks per se that are contributing to body weight. However, the substantial number of studies of stronger methodological quality and design strongly support the recommendation that soft drink consumption be reduced at the population level to help prevent weight gain and reduce the prevalence of obesity.

A causal relationship between soft drink consumption and weight status appears likely as many of the conditions necessary to establish a causal relationship are met from the evidence (Hill 1965).

- Statistically significant associations have been identified in at least eight prospective or longitudinal studies. These indicate a temporal relationship, i.e. soft drink consumption preceded the change in weight status.
- The relationship shows consistency — it is found in various age, sex and racial sub-groups and with varying socio-economic status.
- A dose-response effect has been observed in at least four longitudinal studies (Ludwig et al. 2001; Berkey et al. 2004; Phillips et al. 2004; Striegel-Moore et al. 2006) and this, in particular, has been considered to provide sufficient evidence of causality (Dietz 2006).
- There is coherence in that the association does not conflict with current knowledge about weight gain. Even small imbalances in energy intake and expenditure can have a major impact on weight gain at the individual level. Theoretically, daily consumption of one can of sweetened soft drink (500 kJ) over a 10-year period in a constant environment could lead to a 50 kg increase in weight; although this level of weight gain is unlikely in practice (Ebbeling et al. 2006). Conversely, reducing daily intake by a nominal amount of energy or by increasing energy expenditure (the "energy gap") may help to prevent unhealthy weight gain. Using data from national surveys, Hill et al suggested that altering the energy gap by 420 kJ/day, equivalent to one can of sugar-sweetened soft drink, would prevent excessive weight gain in most adult Americans (Hill et al. 2003). To have a similar preventive effect in children the energy gap may have to be more than 840 kJ/day (Butte and Ellis 2003).
- The theoretical underpinnings of the link between energy intake from soft drinks and weight status are supported by consumption data. Researchers have shown that, among adults in the US, there has been an overall increase of 930 kJ per person per day between 1965 and 2002, and this increase was found to result largely from increased intake of sugar-sweetened beverages (Duffey and Popkin 2007). The data in Australia are less precise as they refer to "non-alcoholic, non-milk beverages" only; however they provide an indication of sugary drinks consumption. A comparison of dietary data from national surveys in Australia in 1983, 1985 and 1995 showed that adults increased their energy intake by around 3–4 per cent (about 350 kJ/day) between 1983 and 1995 (Cook et al. 2001). This was associated with an increase of 166 ml in men and 92 ml of non-alcoholic, non-milk beverages (not including plain water) over the same time period. Between these dates, mean daily energy intake also increased significantly in children, by 11 per cent for girls and 15 per cent for boys aged

10–15 years. Correspondingly, the intake of non-alcoholic, non-milk beverages increased by 200 g in boys and 150 g in girls over the same time period.

Soft drink consumption in Australian adolescents contributed approximately 10 per cent to overall energy intake on a per consumer basis in 1995 (Rangan et al. 2007).

- There are several hypothesised mechanisms to support the biological plausibility of the relationship between soft drink consumption and weight gain:
  - There is usually limited compensation for the energy intake from such beverages, through reduced energy intake from other dietary sources; therefore consuming sugary drinks leads to an overall increase in energy intake (Vartanian et al. 2007; Wolf et al. 2008). Indeed, Vartanian and co-workers (2007) contend that one of the most consistent and powerful findings is the link between soft drink intake and increased energy consumption (see above). Short-term experimental evidence supports the "lack of compensation" hypothesis (Drewnowski and Bellisle 2007). Energy-rich fluids have low satiating properties compared with solids and it is proposed that this leads to a lack of compensation for the energy intake (DiMeglio and Mattes 2000; Swinburn et al. 2004; DellaValle et al. 2005). Wolf et al (2008) examined the history of beverages consumption and indicated that "the failure to secrete important satiety factors that may occur after the ingestion of soft drinks may contribute in a significant way to the failure to compensate when these beverages are ingested".
  - Another possible mechanism includes the glycaemic load of sugary drinks such that appetite control is reduced (Bachman et al. 2006). Similarly soft drink consumption might simply calibrate people to a high level of sweetness that generalises to preferences in other foods (Davidson and Swithers 2004).

In their recent review, Drewnowski and Bellisle dispute the evidence for a causal link between consumption of sugary drinks and weight gain based on physiologic and metabolic grounds (Drewnowski and Bellisle 2007). These researchers contend that the effect of sugar consumption on body weight should not continue to be framed in biological terms, but also depends on behavioural intent and context, and the mode of use, availability and cost of sweetened liquids (refer to Section 3).

4.2 Other Health Implications

The health implications of soft drink consumption in addition to overweight and obesity are listed in Table 4 and explained more fully in the text.

Table 4: Summary of health implications of excessive soft drink consumption

- Displacement of healthier foods from the diet leading to poorer diet quality
- Dental caries and dental erosion
- Bone fractures, low bone density, osteoporosis, hypocalcemia
- Disturbed sleep patterns, bedwetting and anxiety (younger children)*
- Headache, fatigue, decreased alertness, depressed mood and irritability*
- Chronic disease including metabolic syndrome, high blood pressure
- Possible adverse effects due to Benzene

**caffeine-containing soft drinks*

4.2.1 Dental Health

Soft drinks contain large amounts of sugar and are highly acidic, properties which contribute to enamel erosion and dental caries. In the 2003 report on Diet, Nutrition and Chronic Disease (Joint WHO/FAO Expert Consultation 2003), WHO found the evidence for the association between soft drink and fruit juice consumption and risk of dental erosion to be "probable" and the evidence of free sugars contributing to dental caries to be "convincing".

A recent review of soft drinks and dental health indicated that the low pH of soft drinks may lead to erosion of the enamel surface, and the sugars are metabolised by plaque micro-organisms to generate organic acids that bring about demineralisation leading to dental caries (Tahmassebi et al. 2006). One study found that young children (4–7 years) with caries had higher median intakes of regular soft drinks than children without caries (Marshall et al. 2003). Assessment of erosion in 14-year-old children in the UK revealed highly significant correlations with carbonated beverages, sports drinks and fruit juices (Al-Dlaigan et al. 2001). Dental erosion is particularly detrimental in young children, until all permanent teeth are established and enamel maturation is reached (Tahmassebi et al. 2006).

The Australian Dental Association discourages the frequent consumption of soft drinks as well as diet soft drinks, sports drinks and fruit juices due to their high sugar and/or acid content (Australian Dental Association 2002).

4.2.2 Displacement of Healthier Foods from Diet

Soft drink consumption can lead to the displacement of healthier food and beverage choices. A high level of soft drink consumption is associated with lower intakes of a number of vitamins and minerals, and dietary fibre (Harnack et al. 1999; Ballew et al. 2000).

A number of studies have shown that soft drinks displace milk, particularly, from the diet of children and adolescents. National nutrition surveys in Australia (1985 and 1995) indicated that as soft drink consumption by adolescents increased, milk consumption declined by approximately10 per cent (Cook et al. 2001). A longitudinal study of children aged 6–13 years found that excessive consumption of sweetened drinks (> 360 ml/day) displaced half a cup of milk (about 125 ml) from their diet (Mrdjenovic and Levitsky 2003). The consequences were lower daily protein, calcium, magnesium, phosphorus and vitamin A intakes. An early study had also shown that soft drink intake was negatively associated with milk, calcium, magnesium, vitamin A, and vitamin C intake in teenagers living in the US (Guenther 1986). Other longitudinal studies at the population level have found that milk consumption has decreased over time and that this has correlated with an increase in soft drink consumption (Lytle et al. 2000; Blum et al. 2005; Striegel-Moore et al. 2006).

The displacement of milk and thus reduced intake of calcium, particularly among adolescent girls, has implications for short-term and long-term bone health (see below).

4.2.3 Bone Health

Preliminary research suggests an association between soft drink consumption and bone mineral density and bone fractures in children and adults (Petridou et al. 1997; Wyshak 2000; McGartland et al. 2003). Possible explanations for this relationship include the displacement of milk in the diet, or a direct effect of soft drink components. For example, an Australian study attributed the positive association between cola consumption and the risk of wrist and forearm fractures in 9–16 year old children to the effect of caffeine (Ma and Jones 2004). Also, the intake of cola, but not other carbonated soft drinks, has been associated with low bone mineral density in women, suggesting caffeine as the cause (Tucker et al. 2006). Caffeine has been shown to increase the excretion of calcium in the urine (Kynast-Gales and Massey 1994), a potential contributor to osteoporosis. An epidemiological study in Mexico found that consumption of soft drinks with phosphoric acid, included in many soft drinks to give them "bite", was an independent risk factor for developing hypocalcemia (low serum calcium) in postmenopausal women (Fernando et al. 1999).

4.2.4 Caffeine

Cola-type soft drinks, which contain caffeine, currently have the largest share of the beverages market in Australia (Euromonitor International 2006). Caffeine is a mildly addictive stimulant drug which occurs naturally in tea, coffee and chocolate but soft drinks are the main source of caffeine in children's diets (Ellison et al. 1995; Nestle 2000). Levels of caffeine in soft drinks occur in the range of 40–50 mg per 375 ml can. Higher amounts are found in energy drinks (80–120 mg per can, equivalent to one cup of strong coffee), which are forming an increasing share of beverages consumed. The current Australian Food Standards Code allows the addition of caffeine in cola-type soft drinks, flavoured cordials and flavoured syrups, and the total caffeine content must not exceed 145 mg/kg (36 mg / 250 ml serve) in the drink as consumed (Smith et al. 2000).

The link between caffeine in soft drinks and bone health has been indicated in the previous sub-section. In addition, several studies have found a connection between cola drinks and kidney stones (Rodgers 1999; Massey and Sutton 2004) and the US National Institutes of Health currently recommend that people trying to take preventative action should limit their caffeine consumption, including that from cola beverages (National Kidney and Urologic Diseases Information Clearinghouse 2004).

More immediate effects of caffeine on health are also apparent. Caffeine sensitivity (the amount of caffeine that will produce an effect in someone) varies from person to person. On average, the smaller the person, the less caffeine needed to produce side effects. The short-term affirming effects of caffeine include increased energy and attention, enhanced mood and motivation as well as enhanced motor activity, even at low doses (20–200 mg) (Smith et al. 2000). Nevertheless there are considerable negative effects of caffeine consumption, particularly in children and young adults. Negative effects, especially in young children, include disturbed sleep patterns, bedwetting and anxiety, from even modest consumption of caffeine-containing soft drinks. Withdrawal symptoms such as headache, fatigue, decreased alertness, depressed mood and irritability can be experienced 6–24 hours after caffeine abstinence, again even for low doses (Juliano and Griffiths 2004). Avoidance of withdrawal symptoms plays a central role in the habitual consumption of caffeine by increasing the reinforcing effects of caffeine and preference for tastes paired with caffeine (Juliano and Griffiths 2004). This is of particular concern for soft drinks sold to children and adolescents as even low doses can suppress withdrawal symptoms (Evans and Griffiths 1999) which may lead to increased soft drink consumption.

The taste benefit which the beverage industry cites as the reason for adding caffeine to soft drinks has recently been contested by researchers in the US (Griffiths and Vernotica 2000) and Australia (Keast and Riddell 2007). An Australian tasting panel could not detect any difference in flavour between decaffeinated cola and caffeine-added cola, demonstrating that there is no flavour-based rationale to add caffeine to soft drinks (Keast and Riddell 2007). The soft drink industry maintains, however, that caffeine contributes to the flavour profile of cola-type drinks (Australian Beverages Council 2007a).

4.2.5 Chronic Disease

Data from the Framingham Heart Study in the US showed that consumption of greater than or equal to 1 soft drink per day (350 ml) was associated with, in addition to an increased risk of obesity, a significantly increased risk of metabolic syndrome (OR 1.44), waist circumference (OR 1.3), impaired fasting glucose (OR 1.25), higher blood pressure (OR 1.18), higher hypertriglyceridemia (OR 1.25) and higher low-density lipoprotein cholesterol (OR 1.32) (Dhingra et al. 2007). Similarly in the Nurses Health Study II, also in the US, women consuming one or more sugar-sweetened soft drinks per day had an increased risk of type 2 diabetes (RR 1.83) compared with those who consumed less than one of these beverages per month (Schulze et al. 2004).

4.2.6 Benzene in Soft Drinks

There have been a number of recent reports of detectable levels of benzene in soft drinks. The presence of the preservative sodium benzoate and ascorbic acid in drinks can react to produce benzene (Gardnet and Lawrence 1993), especially in the presence of light and heat. These reports have caused concern as benzene is a known carcinogen.

In 2005, the Food and Drug Administration (FDA) in America tested a number of soft drinks for benzene levels (CFSAN/Office of Food Additive Safety 2007). Four out of 100 products were found to contain levels of benzene above 5 ppm, the acceptable limit for drinking water. These products were subsequently reformulated and the FDA believes that the level of benzene found in soft drinks is not a cause for concern. Similarly, the Food Standards Agency in the UK considers that the levels of benzene reported would make only a negligible impact on people's overall exposure to benzene and any additional risk to health is minimal (Food Standards Agency 2006). In Australia, FSANZ analysed 68 flavoured beverages and found that five contained benzene levels above 10 ppm, with a range of 1–40 ppb. FSANZ considers that these levels are not of public health concern, but continues to work with industry to ensure that levels of benzene in beverages are minimised (Food Standards Australia New Zealand 2006).

4.3 The Economic Cost of Soft Drinks

The burden of disease directly related to soft drink consumption is unknown as there are currently no data available for the risk attributable to this dietary behaviour. Nevertheless, the poor health implications of soft drink consumption, particularly obesity and related metabolic diseases including diabetes, and dental caries, are related to substantial health care costs in Australia. Also, many of these diseases are spread inequitably across the socio-economic strata; that is those that are most socio-economically disadvantaged suffer the most from these health problems. Thus targeted action towards reducing soft drink consumption is likely to benefit those groups most at risk of ill-health.

Australia, like many other countries, is experiencing a rapid increase in the levels of overweight and obesity. In Australia, more than 10 per cent of the 2000–01 national health budget (approximately $6.3 billion) was spent on cardiovascular diseases and diabetes, much of which can be directly related to obesity (Australian Institute of Health and Welfare 2005). Overweight and obesity was considered to cause an estimated 7.5 per cent of the total burden of disease and injury in Australia in 2003 (Begg et al. 2007).

With over 60 per cent of the burden of diabetes attributed to obesity and lack of physical activity, the consequences of increasing obesity will be further magnified by reductions in case-fatality from cardiovascular disease — the major cause of mortality in people with diabetes — through successful tobacco control and cholesterol and blood pressure lowering strategies (Begg et al. 2007). This increased survival will mean an increase in the risk of developing other largely non-fatal but disabling consequences of diabetes such as renal failure, retinopathy, neuropathy and peripheral vascular disease. Thus a reduction in soft drink consumption can contribute to reducing this burden.

Oral ill-health accounted for 6.7 per cent (approximately $3.4 billion) of Australia's healthcare expenditure in 2001–02 (Begg et al. 2007).

4.4 The Environmental Cost of Soft Drinks

The processing, manufacturing, distribution and disposal of all containers used for soft drinks uses extensive amounts of energy and water and create environmental emissions.

Manufacturing processes such as cleaning, cooling, and rinsing use large amounts of water. Additional water and energy resources are used in the production of packaging, the transport and the storage of soft drinks. An audit by the UK Government agency "Envirowise" found that 2.5 litres of water was used in the bottling process to produce each litre of soft drink in the UK (Envirowise 2005). Coca-Cola Amatil (CCA) Australia specifies that it has reduced this water usage down to 1.5 litres per litre of soft drinks produced (South East Water 2007) but this is still a large amount. Excessive water use for production, transport and manufacturing of soft drinks and their containers is a particular problem in Australia due to the very limited and finite water resources of the continent.

The energy invested in the production of the soft drinks containers is lost when the container is not recycled. Although all container types — glass, aluminium cans, and polyethylene terephthalate (PET) bottles — can be recycled, a large proportion of soft drinks are consumed away from the home, in areas where there may be limited opportunities for recycling.

Bottled water is not exempt from many of the environmental costs. The environmental impact can start at the source, where some environmental lobbyists claim that local streams and underground aquifers may become depleted when there is "excessive withdrawal" for bottled water. In addition to the energy cost of producing, bottling, packaging, storing and transporting bottled water, there is also the environmental cost of the oil-derived plastic needed to make the PET bottles. Although the environmental impact of PET bottles has been estimated to be less than that of aluminium cans or glass, the cost remains substantial. The environmental cost of bottled water overall, although not as large as that of soft drinks, is thus still substantial and should be borne in mind when considering strategies for reducing soft drink consumption (see Section 6.1).

Section 5

Other Sugary Beverages and Health

5.1 Fruit Juice

In contrast to most sugar-sweetened beverages, pure fruit juices provide additional nutritional value beyond energy. They are currently included as a core food in the Australian Guide to Healthy Eating in which ½ cup (125 ml) of fruit juice is considered equivalent to one serve of fruit. It is generally recommended that fruit juice consumption be restricted to one small glass per day as an excessive juice intake can contribute significant calories and may result in substitution for fresh fruit which contains fibre plus a number of beneficial phytochemicals not present in the juice of fruits.

5.1.1 Weight Status

The energy content of fruit juice is similar to sugar-sweetened beverages such as soft drinks and may contribute to excess energy intake if consumed in large amounts. However, evidence for the link between consumption of fruit juice and obesity is conflicting (Taylor et al. 2005; Vartanian et al. 2007). The review by Taylor et al (2005) concluded that fruit juice may be less obesogenic than other beverages with added sugars and that if any relationship between fruit juice and weight gain in children exists, it is weaker than that of soft drinks and sweetened drinks in general. However, they caution that it is undesirable that children develop a taste for sweet drinks hence fruit juice consumption should be limited.

Two out of four recent studies that have examined the effect of fruit juice on weight in children and adolescents have shown a positive relationship between fruit juice consumption (O'Connor et al. 2006; Sanigorski et al. 2007) and weight gain, whilst two have shown no association (Faith et al. 2006; Tam et al. 2006).

In a study in the US involving 2801 children aged 1–4 years recruited from Women, Infant and Children (WIC) clinics, the relationship between fruit juice intake and adiposity (fat) gain, after controlling for gender and ethnicity, was found to be dependent on initial overweight status (Faith et al. 2006). In already overweight children, each additional serving of fruit juice daily was associated with an excess adiposity (fat) gain of 0.009 SD per month. In contrast, O'Connor et al using data from the National Health and Nutrition Examination Survey (NHANES) 1999–2002, did not find any associations between type of beverage consumed (including fruit juice) and the weight status of preschoolers (O'Connor et al. 2006).

A study of 1944 kindergarten and primary school students in south-west Victoria found that those children who had more than two servings (more than 500 ml) of fruit juice or fruit drink (diluted fruit juice with added water or sugar) the previous day were more likely to be overweight/obese than children who did not, with the odds increasing as the amount of fruit juice/drink consumed increased (Sanigorski et al. 2007). However, in a study involving 268 children (mean age 7.7 years at baseline, 13 years at follow-up) in NSW, intakes of fruit juice/juice drink and milk, were not associated with excess weight gain in early adolescence whilst intake of soft drink and cordial was associated with weight gain (Tam et al. 2006).

One of the mechanisms by which fruit juices might be less obesogenic than soft drinks and other sweetened beverages is that they are consumed mainly by younger children who have better compensation for energy provided in drinks than older children and adults. In addition, water-based beverages make a smaller contribution to the total energy intake of younger children (Alexy et al. 1999; Webb et al. 2006; Rangan et al. 2007). It has also been suggested that fruit juices are more satiating than soft drinks, particularly fresh juices with some fibre content and juices such as "apple" which have a low glycaemic index (Apovian 2004).

5.1.2 Other Health Effects

The evidence for the erosive potential on teeth of fruit juices was considered to be "probable", as it was for sugar-sweetened drinks, in the 2003 report on *Diet, Nutrition and Chronic Disease* (Joint WHO/FAO Expert Consultation 2003). Fruit juice consumption was not associated with risk of diabetes, as soft drinks were, in the *Nurses Health II Study* (Schulze et al. 2004).

5.2 Artificially-Sweetened or "Diet" Soft Drinks

5.2.1 Weight Status

Some studies have linked the consumption of food and beverages containing intense artificial-sweeteners to overeating and weight gain (Blundell and Hill 1986; Davidson and Swithers 2004; Swithers and Davidson 2008). Also data from the prospective Framingham Heart Study (Dhingra et al. 2007) and the San Antonio Heart Study (Fowler 2005; Fowler et al. 2008) recently showed a positive association between BMI and the consumption of regular and diet soft drinks. Similar findings have come from studies of elementary school children (Blum et al. 2005).

It is hypothesised that artificially-sweeteners stimulate appetite or affect mechanisms that regulate hunger and satiety (Rolls et al. 1990; Black et al. 1991; Gougeon et al. 2004) and thus increase appetite for sweet foods. An alternative mechanism is that diet soft drinks might lead to weight gain by disrupting the sensory mechanisms associating sweetness with energy, although Appleton and Blundell (2007) have recently shown that this disruption of the sensory mechanisms might work towards reduced appetite for sweet tastes in habitually high consumers of artificially-sweetened beverages compared to low consumers (Appleton and Blundell 2007). Another explanation for a mechanism by which diet soft drinks might lead to weight gain is that of "consumer rationalisation", i.e. diet soft drink consumers might consider that they are reducing energy intake through drinking diet drinks and hence might consciously feel that they can eat other energy-dense foods more freely than they might otherwise have done. A recent study in the US examined this possibility. The grocery purchases of buyers of diet soft drinks were compared to buyers of regular soft drinks with the aim of investigating the overall energy intake of the different buyers (Binkley and Golub 2007). The study results suggest that the use of diet soft drinks does not lead to compensation by increased purchase (and therefore assumed intake) of high-energy foods. However, the study did show that the highest purchasers of diet soft drink were also the highest purchasers of processed snack foods. Therefore it was considered that snacks have the greatest potential for undermining a strategy based on the control of energy intake through consumption of diet drinks.

In contrast, two recent reviews concluded that intense sweeteners can have a measurable impact on satiety and lower energy intakes (Bellisle and Drewnowski 2007). De La Hunty et al (2006) conducted a meta-analysis of mainly short-term randomised controlled trials and demonstrated that consumption of drinks sweetened with aspartame instead of sucrose resulted in a significant reduction in energy intakes and body weight (de la Hunty et al. 2006). In a review of laboratory, clinical and epidemiological studies, Bellisle and Drewnowski (2007) suggested that humans compensate poorly for previously ingested energy due to an imprecise energy homeostatic mechanism (Bellisle and Drewnowski 2007). Consequently, they argue that diet beverages may represent a plausible strategy for weight control.

A recent randomised controlled intervention trial involving the home delivery of non-calorific beverages including diet drinks and bottled water led to a reduction of 82 per cent in consumption of sugar-sweetened soft drinks in 103 adolescents (13–18 years) after a 25 week period (Ebbeling et al. 2006). The intervention was also associated with significant weight loss, particularly in those children with a higher BMI at baseline. However, the reduction in BMI could not be related directly to diet drinks as no data on the proportion of diet drinks versus bottled water was provided.

5.2.2 Other Health Effects

Diet soft drinks are often promoted as a healthy alternative but they retain some of the components of sugar-sweetened soft drinks which have been associated with ill-health consequences. Diet soft drinks also have high levels of acidity (from carbonic acid, phosphoric acid and citric acid in cola-type drinks) which may contribute to dental erosion when consumed regularly. In addition the diet cola drinks contain caffeine which has been linked to disturbances of the central nervous system (especially in children and adolescents) and to loss of bone mass (see Section 4.2.4).

5.2.3 Safety

The most prevalent artificial sweeteners used in diet drinks in Australia are aspartame and acesulfame potassium, used either singly or in combination (Food Standards Australia New Zealand 2003a). Both sweeteners have undergone rigorous toxicological studies and have been shown to be safe for consumption by humans including pregnant women, children and for people with diabetes (Leon et al. 1989; Yost 1989; Mukhopadhyay et al. 2000; Butchko et al. 2002). Regulatory groups in over 100 countries, including Australia have approved the use of these sweeteners (Food Standards Australia New Zealand 2003b). FSANZ commissioned a dietary survey in 2003 which indicated that the daily exposure of the population to all intense or artificial sweeteners is below acceptable daily intake (ADI), (Food Standards Australia New Zealand 2003a). However concern was expressed for the potential for high consumers of low-joule products to reach their ADI

level of these intense sweeteners (Food Standards Australia New Zealand 2007).

5.3 Milk

5.3.1 Health Benefits

The Dietary Guidelines for Australian Adults (NHMRC 2003a) state the following in relation to milk:

> "Milk itself is one of the most complete of all foods, containing nearly all the constituents of nutritional importance to humans. Milk foods are the richest source of calcium in the Australian diet but are also important contributors to protein, vitamin A, riboflavin, vitamin B12 and zinc. Few other foods provide such a readily absorbable and convenient source of calcium. Calcium is required for the normal development and maintenance of the skeleton. It is stored in the teeth and bones, where it provides structure and strength. In Western cultures low intakes of calcium have been associated with osteoporosis, which often results in bone fracture and is one of the main causes of morbidity among older in Australians, particularly women."

The *Dietary Guidelines for Children and Adolescents in Australia* (NHMRC 2003b) recommend water and reduced-fat milk as the best drinks for children and adolescents over the age of 2 years. (Reduced-fat milks are not suitable for young children under 2 years because of their high energy needs.) Research shows that in Australia many children are not getting enough calcium for healthy growth and development. Therefore, consumption of calcium-rich foods, including reduced-fat plain milk, is encouraged. Flavoured milk often contains added sugar.

5.3.2 Weight Status

A modest number of studies have shown that a high milk consumption is associated with overweight and obesity (e.g. Berkey et al. 2005) although other studies have shown no relationship (e.g. Rajpathak et al. 2006; Wagner et al. 2007). More recently a range of studies in the US have shown that milk consumption is associated with a healthier weight status and may aid weight loss. In a cross-sectional study of over 4000 middle school students, overweight students had a significantly lower consumption of milk than all other students (Roseman et al. 2007). Healthy weight was associated with consuming fruits, vegetables, breakfast and milk. An 8-week prospective study in overweight/obese pre-menopausal women showed that soy milk was as effective as skim milk in promoting weight loss (Lukaszuk et al. 2007). A short-term metabolic study by St-Onge et al. (2007) concluded that, over the longer-term, consumption of milk beverages may have more favourable effects on energy balance than consumption of fruit-flavoured beverages (St-Onge et al. 2007). This finding was based on data relating to a higher daily energy expenditure and thermal effect of food after consumption of milk.

The evidence from experimental studies is conflicting. Some studies have indicated that there are no differences in satiety or subsequent energy intake after preloads with different drinks of equal calorific content: High-fructose corn syrup-sweetened and sucrose-sweetened soft drinks and milk (Soenen and Westerterp-Plantenga 2007). Other studies support the hypothesis that iso-energetic milk products (chocolate milk drink) are more satiating than sweetened soft drinks (cola) and decrease short-term hunger, although differences in subjective appetite scores were not translated into differences in energy intake in the following meal (Harper et al. 2007).

Some studies have identified a role for calcium in improved weight status and weight loss; however whether it is milk per se or whether it is the calcium in milk which impacts on weight status is unclear. A group of studies have shown that calcium intake or dairy intake overall is associated with a healthier weight status (Zemel et al. 2005). Milk has also been found to be beneficial in relation to aspects of the metabolic syndrome (Pfeuffer and Schrezenmeir 2007), as has calcium and dairy products overall (Zemel et al. 2005). For example, in one cross-sectional study in men aged 45–59 years, adjusted odds ratio of metabolic syndrome in men who regularly drank a pint of milk or more daily was 0.38 (0.18–0.78) and that for dairy consumption was 0.44 (0.21–0.91) (Elwood et al. 2007).

5.4 Functional Drinks

5.4.1 Sports Drinks

Sports drinks were designed to aid sport performance as well as provide rehydration after sporting events. They contain 6–8 per cent carbohydrates, usually in the form of sugar, plus other electrolytes (Sports Dietitians Australia 2007). As the name implies, sport drinks are designed for sports participants. Using sport drinks for normal hydration purposes is not recommended because of their energy content (one 600 ml bottle of sport drinks provides around 780 kJ) and their acidity which is associated with the same dental health problems as soft drinks. In Australia sports drinks currently account for less than 5 per cent of the more than 1.3 billion litres of non-alcoholic beverages sold per annum, but the sale of sports drinks is growing faster than most other beverages (*Australian Convenience Store News* 2006).

Sports drinks are often marketed and therefore consumed on a health basis. For example over 60 per cent of males who consume sports drinks claim to do so to give them "energy" and 25 per cent to give them "control", a factor deemed associated with health benefits, and their energy content is indicated to be less than fruit juice (although without reference to relative portion sizes). Marketing messages frequently refer to the need to rehydrate after what might be considered quite modest activity. Sports drinks are promoted by many elite sports teams and are endorsed by some sports medicine and dietetic groups.

The category has also expanded to flavoured waters for kids that generally include a mixture of water (sometimes carbonated), concentrated fruit juice, vitamins, minerals and electrolytes.

Sports drinks are generally considered by health professionals as being suitable only for elite athletes and should only be consumed by children taking part in long periods of strenuous activity, such as at a sports carnival during hot weather. However, most marketing for these beverages is now aimed at the non-athlete (Meadows-Oliver and Ryan-Krause 2007) and they currently have a regular place in the intake of minimally active children or adolescents who already have a high degree of body fat and who may be at risk of excessive energy intake.

5.4.2 Energy Drinks

In recent years, energy drinks have also been introduced as alternative premium products to ordinary soft drinks. Their sales have risen quickly and it has been reported that in the United States energy drinks outperformed all other beverage categories, with more than 500 per cent growth in sales from 2001–06 (Montalvo 2007). *The Australian Convenience Store News* (Nov/Dec 2006) indicates that energy drinks accounted for 22 per cent of total drink sales. Most consumers were in the 15–39 age bracket and consumption is slightly skewed towards males (*Australian Convenience Store News* 2006).

The amount of carbohydrate present in energy drinks (e.g. 10–12 per cent) is similar to soft drinks. The major constituent of energy drinks are sugar and caffeine or guarana (which contains caffeine), but other ingredients such as B vitamins, taurine, ephedrine, inositol and ginseng are usually added as well (Watson 2007). Diet versions which replace sugar with artificial sweeteners are also available. The major concern about energy drinks arises from their caffeine content. In general a 237 ml can of energy drink contains at least 80 mg of caffeine, with some drink sizes containing more than 300 mg. It has been reported that over-consumption of these energy drinks may even lead to death in certain circumstances (Dasey 2007), and one popular energy drink has been banned in France based on its excessive caffeine content (Watson 2007).

Energy drinks may also contain a wide range of other ingredients. Many of these are vitamins, particularly vitamin A and some of the B group vitamins (B2, B3, B5, B6 and B12). Although vitamin supplementation remains popular in Australia, there is no evidence of benefit in healthy individuals or athletes who are not vitamin deficient. Consumption of two servings of some energy drinks may also exceed the recommended safe daily intake of vitamin A and niacin-B3, particularly for children.

One popular use for energy drinks is as mixers to alcohol by young adults. Combining energy drinks and alcohol can lead to several problems, particularly relating to the fact that alcohol is a depressant while energy drinks are a stimulant. Consumption of energy drinks obscures perception of fatigue from drinking; consequently, the mixing of substances tends to increase the amount of alcohol consumed.

5.5 Summary

Sugar-sweetened beverages such as cordials and sweetened fruit drinks, which are consumed more regularly by young children, are likely to have a similar impact on increasing energy and reducing nutrient intake (Gill et al. 2006). Other sugary beverages, such as functional drinks including energy drinks and sports drinks, are emerging and gaining popularity in the market. As they contain large amounts of sugar they have the potential to contribute to an energy imbalance also; however these products still comprise a modest and particular section of the market, and their contribution to overweight and obesity is unknown. Fruit juice is currently considered part of the core food groups in Australia, although intake should be limited. Milk is a core food and is a good source of calcium, a nutrient which may be marginal in the diets of Australian adolescents (NHMRC 2003b).

Section 6

Strategies to Reduce Soft Drink Consumption

In terms of dietary behaviour change, soft drink consumption is probably one of the more straight-forward issues to tackle. Sugar-sweetened beverages are easy to identify and define; they do not constitute an integral part of a meal; consumption requires a conscious decision; and there are direct substitutes. In addition soft drinks are of limited nutritional consequence and there is general acceptance by health professionals of the value of reducing their consumption.

Currently there have been too few intervention trials aimed at reducing the consumption of sugar-sweetened soft drinks to make any firm recommendations concerning the most effective strategies to achieve this objective (Hattersley and Hector 2008). Like many other public health issues it is likely that a combination of strategies will be needed to achieve and sustain behavioural changes. A range of potential health promotion and environmental strategies have been proposed by advocates for change and some of these are examined below.

6.1 Behavioural Goals

Four non-discrete options or intentions for individual-level behavioural changes are:

- Reduce uptake of soft drink consumption by young children.
- Reduce frequency and quantity of soft drink consumption
- Replace soft drinks with artificially sweetened drinks
- Replace sweetened soft drinks with water.

6.1.1 Reduce Uptake of Soft Drinks by Young Children

As taste is the main reason soft drinks are consumed, preventing children from gaining a taste for soft drinks from an early age would likely result in a fall in soft drink consumption at the population level after a period of time. The emphasis in this approach is on preventing toddlers and young children drinking soft drinks, or sugary drinks, regularly and in large amounts in the first instance. Any interventions to achieve this change would likely be most effectively aimed at the family and local community.

6.1.2 Reduce Frequency and Quantity of Soft Drink Consumption

This option would not entail banning or "prohibiting" sweetened soft drink consumption but would recommend consumption in much smaller amounts and less often, in line with the recommendations of the *Australian Guide to Healthy Eating*. The current high levels of sugar-sweetened beverage consumption among Australian children means that small reductions in intake should be relatively easy to achieve and any reduction in soft drink intake has the potential to contribute to a significant reduction in total energy intake. However, relying on this strategy requires constant and consistent reinforcement of the message. Also there is a potential for confusion around the message and for soft drinks to be replaced with other high energy, sugary beverages.

6.1.3 Replace Soft Drinks with Artificially-Sweetened Drinks

The use of intense sweeteners as a substitute for sugar may provide a viable strategy to help people reduce their energy intake without any loss of palatability and has been advocated by several researchers.

This option is likely to be the easiest behaviour change to make as it involves a simple substitution with a similar product (Chacko et al. 2003) and as noted in Section 3.2, taste is a major driver in soft drink consumption. This strategy is also more likely to prevent the replacement of sweetened soft drinks with other high energy drinks. Intervention studies using this approach resulted in a reduction in body weight in adults (Tordoff and Alleva 1990) and had a beneficial effect on body weight in adolescents in the highest tertile for BMI, i.e. those most overweight (Tordoff and Alleva 1990; Ebbeling et al. 2006).

However, there are several concerns about this approach (see Section 5.2). In summary, some studies have suggested that diet soft drinks may have contributed to the trend of increasing obesity, although these findings are contentious. A possible threat to the success of diet drinks as substitutes for soft drinks in the prevention of obesity is that consumers of diet drinks might consume more high-energy snacks. Also, *ad libitum* consumption of artificially sweetened beverages is not recommended,

as the caffeine and acid content of artificially-sweetened soft drinks can have similar negative health consequences to regular soft drinks, such as dental erosion and bone demineralisation. In addition the same environmental concerns exist from the need to collect and recycle non-refillable bottles (Section 4.4).

A recent study showed that mixed alcoholic drinks made with a diet mixer resulted in faster gastric emptying and alcohol absorption compared to those drinks made with a sugar-sweetened mixer (Wu et al. 2006). Therefore the use of diet drinks in association with alcohol might not be advisable.

6.1.4 Replace Soft Drinks with Water

This option overcomes the health issues associated with consumption of artificially-sweetened beverages and would contribute to better hydration. Drinks high in sugar such as soft drinks and fruit juice slow fluid absorption by the body and hence are not as good as water for re-hydration, particularly after sports.

However, water may not have an immediate appeal to high-level soft drink consumers and poor availability of water in public places and the premium price of bottled water is a likely deterrent to increased water consumption in children and those of lower socio-economic status. Also, bottled water currently does not contain fluoride (although this is under consideration by FSANZ) and has environmental costs (Section 4.4) hence any intervention involving this behaviour change should be aimed at using refillable water containers.

There is some evidence that replacing the consumption of sweetened soft drinks with drinking water can help lower total energy intake in consumers who are overweight. A recent intervention in the US evaluated changes in beverage patterns and total energy intakes in 118 over-weight women who regularly consumed sugar-sweetened beverages (Stookey et al. 2007). The replacement of sweetened beverages with water was associated with significant decreases in total energy intake of 840 kJ per day that were sustained over a 12-month period.

An Australian intervention study, The *"Fresh Kids"* program, aimed to influence the lunchbox contents and canteen orders for fruit, water and sweet drinks among culturally-diverse and socio-economically disadvantaged children in the inner-west of Melbourne (Laurence et al. 2007). The intervention used the Health Promoting Schools Approach, and components relating to sweetened drinks included the distribution of student-designed water bottles and water and soft drink policies in the classrooms. Although this study did not employ a comparison group, all schools showed an increase in the proportion of students bringing filled water bottles to school at the end of the two-year period (between 15–60 per cent). There was also a significant decrease (between 8–38 per cent) in the observed proportion of children bringing sugary drinks to school throughout the intervention period. The limitations of this study include a lack of measurement of consumption throughout the day; thus the study was unable to indicate whether compensation might occur, i.e. that students might consume more sugary drinks outside of school to compensate for not bringing them to school. Nevertheless, whole-of-school strategies to promote replacement of sugary drinks consumption with water consumption are considered a promising option for intervention (Hattersley and Hector 2008).

In another study, water did not substitute for soft drinks in a study in high schools in the UK. A nutrition education campaign combined with the provision of water fountains increased the consumption of water in intervention schools, but had no effect on soft drink sales, although this was in an environment where soft drinks were readily available (Loughridge and Barratt 2005).

A recent qualitative study reported on adolescents attitudes to overweight/obesity and what they felt would work for them (Wilson 2007). This study noted that adolescents are willing to drink more water but are not willing to give up soft drinks.

Instead of water, the consumption of lower energy "healthier" alternatives could be promoted. This could include beverages such as flavoured waters (carbonated and non-carbonated) for children (see Section 5.4). However, such products do not encourage children to consume plain water; on the contrary they habituate children towards having beverages that are flavoured and sweet-tasting. There are also issues with many of the alternative beverages in terms of acidity. In addition, many are packaged in PET bottles, with associated environmental problems (Section 4.4).

6.2 Social Marketing and Public Education

The limited social research on attitudes to soft drink has shown that there is a lack of awareness of the potential health consequences of excessive soft drink consumption and that a reduction in consumption is not seen as a high priority dietary change, particularly among those high risk consumers. Increased awareness of the issue of soft drinks is therefore needed. Social marketing is one way to achieve this awareness, and also functions to move people along the pathway to achieving dietary change, i.e. initiating and maintaining change.

Social marketing is the systematic application of marketing concepts and techniques to achieve specific behavioural goals, to improve health and reduce health inequalities (French and Blair-Stevens 2005). Social marketing can reinforce, by consistent and appealing imagery, the educational messages which consumers are receiving from more direct sources (Lyle 2004). It has been shown to be an effective and cost-efficient approach in addressing the health needs of low-income populations throughout the world.

6.2.1 Social Marketing and Healthy Dietary Behaviours

There have been several recent reviews of social marketing approaches to promoting health and healthy nutrition practices and environments (Gordon et al. 2006). The earlier review by Alcalay and Bell (2000) found that the evidence showed limited effectiveness, although the reviewers noted that social marketing may be effective at preventing adoption of unhealthy behaviours, as opposed to changing "ingrained" behaviour (Alcalay and Bell 2000). However, the later reviews of Thornley et al. (2007) and Gordon et al. (2006) have found that, although social marketing interventions aimed at improving nutrition are relatively new and an empirical evidence-base is still emerging, there is strong evidence that social marketing nutrition-related interventions can be highly effective. Importantly the reviews showed that effective nutrition-related social marketing can occur with nearly any target group (whole population, ethnic groups, children, low income) and in nearly any setting (schools, home, workplaces, churches, and the wider community). Evidence was relatively stronger for interventions targeted to low income populations in home and school environments.

The review by Thornley et al (2007) highlights two papers that involved social marketing to reduce sugar-sweetened drinks consumption. These papers were included in a recent evidence update of interventions to reduce consumption of soft drinks and increase consumption of water (Hattersley and Hector 2008). Both programs aimed to reduce the availability of sugar-sweetened drink at home. The intervention by McGarvey et al (2004), was a non-randomised, controlled, one-year prospective study involving 186 WIC (Women, Infants and Children) program parents with 2–4 year old children (McGarvey et al. 2004). The intervention involved education, staff reinforcement, and community reinforcement, grounded in social cognitive theory and self-efficacy theory. An educational group met every two months and meetings were held with a WIC nutritionist every 6 months. One of the educational messages was 'drink water instead of sweetened beverages'. Spanish-speaking participants reported at the end of the program offering their child water instead of sweetened beverages more frequently compared with English-speaking participants.

The Memphis GEMS (Girls Health Enrichment Multi-Site Studies) Program (Beech et al. 2003) was aimed at preventing excess weight gain in pre-adolescent African-American girls, and one of the nutrition objectives was to increase water consumption and reduce sweetened beverage intake. A treatment group which involved parental education sessions and take-home materials to reinforce key points led to a 34 per cent decrease in servings of sweet beverages and 1.5 per cent increase in water servings. There was some indication, as in the WIC intervention, that there may be cultural differences in preferences for, and the effectiveness of, this particular approach. Many participants also indicated they would have preferred a joint parent-child intervention.

6.2.2 Social Marketing and Other Health Behaviours

There have been large and successful campaigns aimed at other health behaviours in the US and Australia. For example, the VERBTM campaign, a social marketing campaign aimed to increase physical activity among youth, has been shown to positively influence children's attitudes about physical activity and their physical activity behaviours (Huhman et al. 2007). These authors concluded that, with adequate and sustained investment, health marketing shows promise to affect the attitudes and behaviour of children.

Wong et al (2004) described the essential components of the campaign involving the "four 'P's" of marketing. The four P's are:

- *Product* — is the desired behaviour for the targeted audience.
- *Price* represents a balance of product benefits and costs to a consumer.
- *Place* is where the target audience either performs the behaviour or accesses programs or services — place must be readily available to enable the desired action.
- *Promotion* is not simply the placement of advertisements — communication messages and activities are included as well. Those in charge of *Promotion* must consider multiple ways to reach the target audience to promote the benefits of the behaviour change, including its product, price, and place components.

The four "P's" were used to plan social marketing

strategies to reduce the consumption of alcohol on and off campus among university students in the US (Zimmerman 1997). Interestingly, one of the messages of this program was to promote soft drink as an alternative to alcohol, with the slogan 'cold one as a reward for hard work', with soft drink cans prominently displayed in the advertising material. Investigation of the materials used in this program and other alcohol-prevention programs could perhaps inform a campaign to reduce soft drink consumption and/or drink more water.

Another social marketing campaign in the US has achieved steady positive changes in attitudes, beliefs and intentions related to cigarette smoking as well as reaching the ultimate target of reducing cigarette smoking in youth. Cigarette use among high schoolers dropped from 28 per cent to less than 23 per cent — a drop of more than 1 million smokers — in the 2 years following the debut of the program. The focus of the Truth[sm] campaign is not solely on the health effects of tobacco nor does it warn youth not to smoke; it provides information about tobacco, the tobacco industry, and the social costs of tobacco use while encouraging teens to take control of their lives and to reject the influence of the industry's advertising practices (Eisenberg et al. 2004). A valuable finding from the campaign was the usefulness of the Truth[sm] tour — field marketing activities involving "edgy" youth travelling throughout the US as "ambassadors" of the campaign (Eisenberg et al. 2004). Evaluation of the tour showed that social marketing campaigns should also create linkages at the local level to ensure that the brand and message are sustained in the community after the tour leaves town. These linkages should be carefully chosen to ensure that they embody the image of the campaign. Ultimately field marketing techniques were considered important to the success of the campaign (Eisenberg et al. 2004).

Particular points that emerge from the literature around social marketing and healthy behaviours among adolescents and young adults are summarised in Appendix 1, which also contains a list of more general lessons learned from reviews of social marketing of nutrition-related behaviours.

6.2.3 Current Social Marketing Initiatives aimed at Dietary Behaviours

Information can also be gleaned from current, as yet not evaluated, social marketing programs aimed at changing dietary behaviours. For example, a current social marketing strategy in New Zealand Feeding our Futures (delivered by the Health Sponsorship Council NZ) is aimed at encouraging parents and caregivers to adopt new strategies to improve their children's diets. "Make water or milk the first choice for your children" is one of the key messages of this program.

Other useful hints towards program planning and development in nutrition-related campaigns can be found at the following website: **www.nsms.org.uk**. This website includes details of the Healthy Living Social Marketing Initiative report which provides answers to the following key questions:

- What in people's behaviours place them at risk of unhealthy weight gain?
- What drives their current behaviours?
- How might they be motivated to change?
- Who might be able to influence them?
- What might act as barriers to change?

In addition, the *Kids Healthy Eating and Physical Activity Program* currently being implemented within the Hunter / New England region of NSW has a social marketing element which focuses on replacing sweetened drinks with water.

6.2.4 Social Marketing Aimed Upstream

There is an important role of social marketing beyond the focus on the public consumer; there is evidence that social marketing can work "upstream" as well as with individuals (Gordon et al. 2006). That is, social marketing can be used to influence policy makers who can address the broader social and environmental determinants of health. As Donovan and Henley (2004) note, social marketing should target individuals and groups in legislative bodies, government departments, corporations, and non-profit organisations, who have the power to make policy, regulatory and legislative changes that would affect soft drink availability and accessibility.

6.3 Potential Environmental Strategies

Public health theory and practice has shown that individual-level behaviour changes are unlikely to occur and be sustained without supporting environmental changes. Action at the macro-environmental level should aim to decrease the availability and appeal of soft drinks while concurrently increasing the availability and access to alternative beverages. A variety of reports have identified some key structural issues that could influence soft drink consumption (Joint WHO/FAO Expert Consultation 2003; Jacobson 2005; World Health Organization Europe 2007). These relate clearly to the identified determinants and factors affecting soft drink consumption (Section 3) and include: access, price, portion size, marketing, labelling and packaging and product reformulation.

6.3.1 Reduction of Access to Soft Drinks/ Increased Access to Water

A number of government agencies have already moved to reduce the access of children to soft drinks and increase their access to alternative beverages, in particular water. In recent years, sugary drinks such as soft drinks, have been banned for sale from school canteens in public schools in New South Wales, Victoria and South Australia and Western Australia. These restrictions could be extended to other government institutions such as hospitals and state-controlled recreation and sporting venues. However, it is difficult to directly influence the ready access to soft drinks in most other public places in Australia through vending machines, convenience stores, supermarkets or kiosks.

A preferable strategy in these situations might be to improve the access to alternative beverages. The provision of clean and free water in public places may decrease the demand for sweetened drinks. In Sweden it is compulsory to provide access to free water in all venues where food is served, and in New South Wales and Western Australia it is mandatory to serve cold tap water either free of charge or at a reasonable price if the restaurant is licensed to serve alcohol (Department of Racing Gaming & Liquor 2007; NSW Office of Liquor Gaming and Racing 2007).

The provision of chilled water dispensers in community stores in rural and remote Australia could be explored. A very modest charge could be made for the filling of re-useable bottles.

The provision of cooled water filters in the APPLE Project was part of a multi-component two-year pilot nutrition and physical activity intervention program in primary schools in New Zealand (Taylor et al. 2007). Immediately post-intervention, children in the intervention schools reported consuming fewer carbonated beverages, fruit juice or drinks and total sweet drinks than control children, although these differences were primarily due to increases in consumption of sweet drinks in the control children during this period. Water consumption did not differ significantly between groups post-intervention and BMI was only reduced in students who were not overweight at baseline.

6.3.2 Price Increase Through Taxation

The introduction of a tax on soft drinks and other snack/ junk foods (snack tax) has been the subject of considerable discussion in past years (Battle and Brownell 1996). The suggestion has arisen from the long history of successfully taxing tobacco products and alcoholic beverages (Kuchler et al. 2005) and such "snack taxes" have already been in practice in many developed countries, such as Canada and the USA (Leicester and Windmeijer 2004; Chouinard et al. 2007). A recent study using novel empirical evidence has shown strong associations between the presence of state-level taxation on soft drinks or snack foods between 1991 and 1998 and relative changes in obesity prevalence over the same time period (Kim and Kawachi 2006). This article emphasises some of the gaps and priorities regarding this approach which should be addressed in future research and policies.

On average, consumers around the world allocate about 1.1 per cent of their income on soft drinks (Selvanathan and Selvanathan 2005). Some researchers consider that the relatively low cost of soft drinks is a major factor affecting their consumption (e.g. Drewnowski and Bellisle 2007) as soft drinks and other "extra" foods are relatively cheap compared to healthier alternatives. However, soft drink is considered to be relatively price inelastic as the intake of soft drink does not appear to be blunted much by increases in price. A worldwide value for the elasticity coefficient has been determined to be -0.6 (Selvanathan and Selvanathan 2005). That is, a 10 per cent increase in the price of soft drinks would likely result in only a 6 per cent decrease in purchases. Although small taxes on soft drinks have been suggested to be the most viable solution (Jacobson and Brownell 2000), a larger tax would need to be imposed to affect consumer choice to the extent that health improvements are seen (Kuchler et al. 2004; 2005). However smaller taxes could be sufficient if taxing is combined with alternative approaches to reducing soft drink consumption (Caraher and Cowburn 2005).

Also, proponents of the imposition of a soft drinks tax suggest the earmarking of revenue generated from such taxes for nutrition education programs, that are currently under-funded (Jacobson and Brownell 2000). Even a modest taxing of soft drinks would likely return substantial revenue. For example it has been estimated that continued funding of the highly successful $300 million-a-year youth anti-smoking social marketing campaign in the US, Truthsm, would require only 1.5 cents per pack of cigarettes (Krisberg 2004).

The revenues could also subsidise the cost of core, healthier foods such as fruit and vegetables (Brownell 1994; Battle and Brownell 1996; Kuchler et al. 2004; Kim and Kawachi 2006), or, specifically in the case of soft drinks, improved availability and access to fresh water.

Adversaries of a soft drink or snack tax argue that such taxing violates basic taxation principles as people from the lower socio-economic groups are among those who are the highest consumers of soft drinks; thus it is imposing a financial burden on them (Pasour Jr 1995; Bahl 1998).

However, as this group in the community are also the most price sensitive, it could be argued that it is reasonable to target them in this way to achieve an appropriate health outcome. Pasour also speculates that "revenues from the tax are not generally used to provide special benefits to consumers or businesses affected by the tax" although there is evidence that these benefits to consumers can be attained, such as has happened with the fuel tax in Australia. Additionally, opponents to such a tax indicate that revenue collected will gradually diminish as consumers buy fewer snack foods and soft drinks (Kuchler et al. 2005). Thus, with the revenue decreased, there will not be sufficient money to fund the nutrition education programs in the long term; and short-term nutrition education programs were deemed unlikely to offer long-term weight reduction (Kuchler et al. 2005).

However the excise tax imposed on alcohol and cigarettes has been demonstrated to be successful in reducing consumption of both products through price increases when combined with public health education programs funded from the tax. Also, van Baal et al considered that even if the tax revenues generated by the tobacco tax are not earmarked specifically to the healthcare budget, increasing the tax on tobacco is still a cost-effective intervention for decreasing cigarette smoking (van Baal et al. 2007). This may be true for soft drinks also.

6.3.3 Reducing Portion Sizes

The trend of increasing portion sizes has occurred in parallel with the prevalence of overweight and obesity (Young and Nestle 2002; Nielsen and Popkin 2003). Thus it has been postulated that the increase in portion sizes of sugar-sweetened beverages may play a role in the obesity epidemic (Young and Nestle 2002; Matthiessen et al. 2003). Data around the world has provided solid evidence of an increase in portion size for many food products including soft drinks over time (Young and Nestle 2002; Matthiessen et al. 2003; Smiciklas-Wright et al. 2003; Young and Nestle 2003).

The size of containers for beverages has increased 2–3 fold over the last 50 years. In the 1950s the standard serving size was a 200 ml bottle, in comparison with the most commonly consumed containers today which are the 390 ml and 600 ml bottles. Also, with the price of the 600 ml bottle being only marginally higher than its 390 ml counterpart, this makes the 600 ml bottle appeared to be a "bargain buy" as suggested by Young and Nestle (Young and Nestle 2002). The choice of the larger container size would result in an extra intake of 378 kJ. Also, the prevalence of the 600 ml bottle means that it becomes "the norm" and is viewed as a single serve, further increasing the possibility of over-consumption of energy.

Other evidence of the positive association between portion size and consumption was summarised in Section 3.3.2.

6.3.4 Restricting Marketing to Children

Section 3.3.4 indicated that exposure to food and beverages advertising via TV is associated with a higher consumption of soft drinks. Over 30 countries, including the UK, Australia and Canada, have already imposed some limitations on television advertising to children, while Norway, Sweden and parts of Canada (Quebec and, most recently, Toronto) have imposed a ban on television food and beverages advertisements to children under 13 years (Hawkes 2004).

There is some evidence to suggest that the increase in proportion of overweight children in countries which limit "junk-food" advertising has been slower than in those without such limits (James et al. 2002) but the real impact of advertising restrictions is difficult to assess.

Recent analyses suggest that the TV advertising of soft drinks to children may be declining but more pervasive forms of electronic marketing such as websites, children's magazines, product placement and star endorsements are replacing them (Kelly and Chapman 2007). There are large numbers of advertisements for soft drinks around primary schools in Australia, and probably in train stations and bus shelters too (Kelly et al. 2008).

Recently the US Centre for Science in the Public Interest developed the "Global Dump Soda Campaign" aimed at curtailing the promotion of soft drinks to children. In 2007, Consumers International called for companies to "cease the marketing of all sugar-laden beverages to children under 16 years, including print and broadcast advertising, product placement, the internet, mobile phones, athletic sponsorship, signage, packaging promotions, merchandising and other means".

Restricting marketing of soft drinks to children will require considerable action across many sectors with sustained advocacy of decision makers. However, local action can be implemented at the level of schools, workplaces, sports events and community settings.

6.3.5 Labelling and Packaging

A potential strategy to discourage soft drink consumption is the inclusion of a label with either a warning message, e.g. "excessive consumption of soft drinks can lead to undesirable weight gain", and/or the caloric content of the beverage in the container in big print. A recent US

study by Bergen and Yeh demonstrated that brightly-coloured *"0 calorie, 0 carbs"* labels on the selection panels together with motivational posters around vending machines which sold drinks significantly encouraged university members (students and staff) to select either bottled water or diet soft drinks over sugar-sweetened soft drinks (Bergen and Yeh 2006).

6.3.6 Product Reformulation

A reduction in the sugar content of sugar-sweetened beverages and soft drinks may assist in reducing the poorer health consequences of soft drink consumption. With an increasing public desire for healthier products in general, reduced sugar variations of some soft drink products have been manufactured and sold in the USA and Europe. Despite predictions that this would be a growing market, many of these drinks, including a reduced sugar version of Coca Cola, have been withdrawn from sale after only a short period.

The flatness of sales of carbonated drinks has pushed producers to expand their product range towards products which can be marketed as "healthier" options with "no artificial colours, flavours or preservatives" and added vitamins and minerals or concentrated fruit juice. Such products are available for older children and adults and are also aimed at the younger consumer. For example, blends of fruit juice and carbonated water have been designed to meet Australian tastes.

Section 7

Conclusions

The review of the literature surrounding consumption of soft drinks has led to a number of conclusions in support of action to reduce soft drink consumption at the population level in NSW and Australia. These are listed in Table 5, below, and discussed more fully in the text.

Table 5: Conclusions concerning priority actions to reduce soft drink consumption at the population level in NSW and Australia

1. Soft drink consumption is one of a portfolio of dietary behaviours that should be targeted in the prevention of obesity.
2. Promotional efforts to reduce soft drink consumption should comprise a whole-of-population approach as well as targeting vulnerable and high-risk subgroups of the population.
3. Research into the determinants of soft drink consumption, particularly among different target groups, is needed to guide action.
4. Reduction of population soft drink consumption requires a multi-faceted communication strategy.
5. Additional high quality innovation and applied research will help improve the effectiveness of current interventions to reduce soft drink consumption:
    a. Research and evaluation of promising population approaches to decreasing soft drink consumption is needed.
    b. Research is also required to fill gaps in the evidence base on behavioural interventions to decrease soft drink consumption, such as reducing soft drink availability in the home and improving parental modelling, and interventions among young adults.
    c. Sound evaluation methods should be employed involving measurement of daily consumption of **all** beverages (including water), ideally for several or more days including weekdays and weekend days.
6. In addition to population communication and behavioural strategies, more environmental strategies to reduce soft drink consumption are needed.
7. The regular monitoring of dietary behaviours, including soft drinks and other sugary drinks consumption, as well as water consumption, is necessary at the state and national level.
    a. The continuous NSW Population Health Survey is a source of data on population soft drink consumption; however other questions relating to sugary beverages and water consumption would be a useful addition for future surveys.

7.1 Investment in Reducing Soft Drink Consumption

Conclusion 1 — Soft drink consumption is one of a portfolio of dietary behaviours that should be targeted in the prevention of obesity.

There is sufficient evidence to indicate that soft drink consumption is contributing to levels of overweight and obesity. Soft drink is a distinct beverage that is easily-identifiable and does not provide any nutritional value, other than sugar (energy), and hydration which can be readily obtained from less energy-dense sources. Soft drink is considered an extra food in the Australian Guide to Healthy Eating (AGHE). A reduction in consumption will accrue other health benefits, including improved dental and bone health.

7.2 Target Populations

Conclusion 2 — Promotional efforts to reduce soft drink consumption should comprise a whole-of-population approach as well as targeting vulnerable and high-risk subgroups of the population.

Whole-of-population

Not everyone in the community consumes soft drink but one- half of adolescents and young adults and around one-third of adults in general report being consumers (1995 NNS; section 2.3.1). The value of a whole-of-population approach is supported by the lack of awareness in the general community about the health issues associated with excessive soft drink consumption. Also, environmental strategies relating to price, taxation, access, marketing, labelling and portion size can generally be applied only at the population level.

High risk consumers:

There are several sub-groups whose soft drink consumption patterns and/or increased susceptibility to health consequences of excess consumption make them high risk consumers. This approach concurs with a necessary equity focus where the "Four steps towards equity tool" developed by South Eastern Sydney Area Health Service provides a useful guiding tool. (**http://www.health.nsw.gov.au/pubs/2003/pdf/4-steps-towards-equity.pdf**). These groups are:

- *Teenagers, especially males and particularly those of Middle Eastern and Southern European descent.* Overweight and obesity is prevalent and soft drink consumption is high among male adolescents of certain cultural backgrounds. Adolescent males might require tailored assistance to reduce their soft drink consumption with messages highlighting the disadvantages of soft drink consumption, the endorsement of healthy alternatives and targeting self-efficacy with specific behavioural advice. Cultural groups will require appropriate, culturally-targeted health promotion messages and programs.
- *Young adults*, aged 19–24 years are high consumers. Messages to reduce soft drink consumption should not conflict with other health promotion programs, particularly those aimed at a reduction in alcohol consumption.
- *Indigenous communities*. As well as consuming more soft drinks than non-Indigenous Australians (Section 3.1.2, and Flood V pers. comm.), Indigenous Australians are more susceptible to weight gain and obesity, have poorer dental health and are more likely to have diets low in important nutrients. High levels of overweight and obesity, and diabetes, in this target group have been highlighted in several recent papers (Craig et al. 2007; McDermott et al. 2007).
- *Families, particularly of lower socio-economic status and/or where the mother has a low level of education.* Any portfolio of interventions should include a focus on the family unit. The family unit is important as many nutrition beliefs, attitudes and behaviours are modelled by parents to children, and parents purchase the household food and beverages consumed by children. They are an important group to target in order to limit uptake of soft drinks in younger children, preventing regular consumption becoming an established behaviour. Families of low socio-economic status, particularly where the mother has a low level of education, have high rates of overweight and obesity and high rates of soft drink consumption.

  Promotional efforts aimed at parents of young children, particularly those that are more socio-economically disadvantaged, should therefore be an integral component of a portfolio of interventions aimed at reducing soft drink consumption overall. Promotional activities should target:

  – reduced personal consumption (role modelling)
  – reduced soft drink availability in the home
  – not offering soft drink to young children
  – not offering soft drink to any children in the home on a regular basis.

7.3 Implications for Qualitative Research

Conclusion 3 — Research into the determinants of soft drink consumption, particularly among different target groups, is needed to guide action.

There is currently insufficient knowledge concerning the barriers to reducing soft drink consumption, and to the beliefs, attitudes and facilitators of soft drink consumption amongst various population subgroups. Most of the qualitative research has been in adolescents, where the findings to date have limited potential to inform action. Qualitative research into the determinants of soft drink consumption among different target groups will inform promotional efforts including intervention research (Conclusion 5). In particular there is no clear indication of which behavioural approach will work best and it is likely that different approaches will work best with different target groups.

7.4 Public Education/Social Marketing Campaign

Conclusion 4 — Reduction of population soft drink consumption requires a multi-faceted communication strategy.

There is a lack of awareness of the potential health consequences of excessive soft drink consumption in the general community in NSW and Australia. There is strong evidence that social marketing can be highly effective in changing nutrition-related attitudes, beliefs and behaviours. Public education can make people more receptive to other promotional efforts. A multifaceted communication strategy could be employed, involving a number of campaign waves or stages, addressing the whole population as well as specific target groups listed above (Conclusion 2). Different groups will require different messages, although an overarching message should be that of the AGHE, i.e. "soft drinks should only be consumed occasionally and in small amounts". Formative research, as indicated in Conclusion 3, would inform such a campaign. There may be value in targeting another nutrition or health-related behaviour concurrently.

7.5 Innovation and Applied Research Regarding Potential Approaches

Conclusion 5 — Additional high quality innovation and applied research will help improve the effectiveness of current interventions to reduce soft drink consumption

Conclusion 5a — Research and evaluation of promising population approaches to decreasing soft drink consumption is needed.

Conclusion 5b — Research is also required to fill gaps in the evidence base on behavioural interventions to decrease soft drink consumption, such as reducing soft drink availability in the home and improving parental modelling, and interventions among young adults.

Conclusion 5c — Sound evaluation methods should be employed involving measurement of daily consumption of ALL beverages, ideally for several or more days including weekdays and weekend days.

The four behavioural approaches to enabling a population-level decrease in soft drink consumption are:

- Reduce uptake of soft drinks by young children
- Reduce frequency and quantity of soft drink consumption
- Replace soft drinks with water (or low sugar alternatives)
- Replace soft drinks with artificially-sweetened drinks

However the evidence-base for behavioural interventions to reduce consumption and limit uptake of soft drinks is currently extremely limited. Several approaches that hold promise, but require further research and evaluation, include:

- Promoting the use of refillable water bottles (Laurence et al. 2007)
- Encouraging parents to offer water to children (McGarvey et al. 2004)
- Parent-child education (Beech et al. 2003)
- Using electronic media to promote a reduction in soft drink consumption among young adults (Hattersley and Hector 2008).

There are a number of potential points of intervention that have not yet been trialled hence are areas for future research; for example interventions aimed at reducing soft drink availability in the home and improving parental modelling behaviours to reduce soft drink consumption among children and adolescents. Young adults are a target group that has received little attention to date.

The currently scant intervention evidence is further limited by a lack of complete evaluation of beverages consumption. For example, many studies have measured water and/or soft drink consumption only while at school thereby not allowing for compensatory effects, i.e. increased consumption outside of the school environment. Few studies have measured consumption at weekends and during the week. Also, there is a lack of evidence that promoting and increasing water consumption leads to a reduction in soft drink consumption. Therefore intervention studies must include a sound evaluation component that uses reliable and valid methods involving measurement of all drinks (including soft drinks, fruit juices, water, milks, alcohol etc) consumed daily, ideally on several or more days including weekdays and weekend days.

7.6 Environmental Changes

Conclusion 6 — In addition to population communication and behavioural strategies, more environmental strategies to reduce soft drink consumption are needed. Such strategies should aim to address issues such as access, price, portion size, marketing, labelling and packaging, and product formulation.

Individual-level behaviour changes are unlikely to occur and be sustained without supporting environmental changes. Although environmental changes are largely outside the direct influence of NSW Health, there is a need to support such changes wherever possible. Support could include direct action such as "leading by example", e.g. increasing the placement of bubblers in health services waiting rooms and removing vending machines selling soft drinks from health services.

7.7 Monitoring

Conclusion 7 – The regular monitoring of dietary behaviours, including soft drinks and other sugary drinks consumption, as well as water consumption, is necessary at the state and national level.

Conclusion 7a – The continuous NSW Population Health Survey is a source of data on population soft drink consumption; however other questions relating to sugary beverages and water consumption would be a useful addition for future surveys.

There is a lack of data relating to dietary behaviours in Australia. Dietary surveys are carried out irregularly and infrequently at the national level despite the regular monitoring of particular dietary behaviours, such as soft drinks consumption, being essential to determine if promotional efforts are working. Ideally such monitoring would enable determination of consumption patterns and amounts among different population sub-groups. The continuous NSW Population Health Survey includes a nutrition module containing short questions to determine frequencies of food and beverage consumption, including two questions about sugary beverages. It therefore provides some data about the consumption of sugary drinks in NSW, over time. Other questions relating to amount and determinants of sugary beverages and water consumption would be useful additions to all future surveys, including questions about soft drink, diet soft drink, fruit juice, and water consumption.

Glossary

Term	Definition
Acceptable daily intake	The amount of a specific substance that can be ingested throughout the lifetime without an appreciable adverse health effect. Usually expressed in milligrams per kilogram body weight per day.
Adiposity	The quality or state of being fat.
BMI *z*-score	BMI *z*-scores are a way of defining how far children's current BMI varies from the mean. As a child's BMI will naturally vary with age and differ between gender and so it is useful to transform their actual BMI measurement into a *z*-score which allows comparison over time and across different age groups and genders. The BMI *z*-score is calculated using reference BMI for age percentiles and determining the number of standard deviations from the mean.
Body mass index (BMI)	BMI is the body weight in kilograms divided by the square of height in metres (km/m^2). In Caucasian adults, $18.5 \leq BMI < 25$ represents normal weight, $25 \leq BMI < 30$ represents overweight, and $BMI \geq 30$ represents obese.
Chronic diseases	This term applies to a diverse group of diseases, such as heart disease, cancer and diabetes (to name a few), that tend to be long-lasting and persistent in their symptoms or development. Although these features also apply to some communicable diseases (infections), the general term chronic diseases is usually confined to non-communicable diseases.
Confidence interval (CI)	A confidence interval is a range of values that includes the parameter with known probability, called the confidence level. The confidence level represents the probability that a sample will actually have the value of the parameter in the confidence interval.
Cross-sectional study	A study that examines different variables in a population to describe the nature and incidence of disease or behaviours at a particular point in time. Risk factors and outcome measures are determined simultaneously, i.e. no temporal relationship can be identified.
Efficacy	Efficacy relates to the ability to produce a beneficial effect under ideal conditions and effectiveness relates to the demonstration of a beneficial effect within the community or population group.
Ginseng	The root of *Panax sp*., usually *Panax ginseng*. It is a well known medicinal plant in China, mainly used for its mental and revitalizing effect on the body.
Glycemic index (GI)	Glycemic index is a ranking of carbohydrates based on their immediate effect on blood glucose levels. Carbohydrates that break down quickly have the highest GIs; the glucose response is fast and high. Low GI foods affect appetite by keeping a feeling of fullness for longer, while low GI diets may help weight loss.
Glycemic load (GL)	Glycemic load is given by multiplying the carbohydrate content of a food (in grams) by its glycemic index (as percentage).
Guarana	A herb that contains an alkaloid similar to caffeine.
Hypertriglyceridemia	An excess of triglycerides in the bloodstream.
Indigenous	In Australia this term usually describes a person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander and is accepted as such by the community with which he or she is associated.
Interventions	Interventions include policies, programs or actions intended to bring about identifiable outcomes.
Low-density lipoprotein cholesterol	A form of cholesterol in the body which carries cholesterol from the liver to the peripheral tissues. When oxidised, it forms atherosclerotic plaque which narrows the arteries, therefore commonly known as the "bad" cholesterol.
Morbidity	Refers to ill health in an individual and to levels of ill health in a population or group.
Mortality	Death.

Term	Definition
Neuropathy	Disturbance or damage to the nerves.
Nurses Health Study II	A prospective cohort study of 116,686 women from the nursing profession in the US aged 25–42 years at baseline. A range of diet, lifestyle factors and health outcomes have been investigated. Dietary information has been obtained by food frequency questionnaire at four-yearly intervals since 1989.
Obesogenic	Contributing to a positive energy balance and weight gain. The term is usually applied to the prevailing physical, social and political environment.
Odds ratio (OR)	The odds ratio is a measure of risk or association used in comparative studies. It is a measure of the odds of the disease or event in the exposed or intervention group compared to the odds of the disease or event in the control group. An OR of 1 represents no association, OR > 1 represents an increased risk and OR < 1 represents a decreased risk.
Peripheral vascular disease	Narrowing or blockage of the arteries other than those of the heart.
Phytochemicals	A non-nutritive bioactive plant substance, such as a flavonoid or carotenoid, considered to have a beneficial effect on human health. Also called *phytonutrient*.
Prospective study	A study where participants are followed forward in time, usually to assess the relationship between an exposure variable and future health outcome(s). Also known as a cohort study.
Renal failure	A decline in the ability of the kidneys to remove excess fluid and filter the blood.
Retinopathy	Damage to the retina, frequently affecting the small blood vessels.

Appendix 1

Lessons Learned from Social Marketing Strategies to Encourage Healthy Behaviours

There are particular points that emerge from the literature around social marketing with regard to adolescents and young adults:

- Projects that use media with entertainment value (movies, soap operas, radio plays, music, theatre, comics) are likely to be particularly successful with adolescents and young adults. Members of the target group can identify with the heroine/hero or with a well-known idol and this has a motivating effect in the desired direction of change.
- Use of electronic media, including the internet and mobile phones, has the potential to be reach large numbers of this age group, and offer strategies that are appropriate and sustainable (Rodgers et al. 2005; Arthur et al. 2006; Cousineau et al. 2006).
- There have been recommendations that making the risks known and making the alternative if not "cool", then at least an acceptable choice within peer groups, is important. Defining the product as "edgy" (on the leading edge of popular youth culture) as in the VERB and Truth[sm] social marketing programs appears to be especially appealing, particularly to the high risk target groups. Henley and Donovan (2003) showed that young Australians do not consider themselves immortal and responded equally well to death-threats and non-death threats in relation to anti-smoking messages (Henley and Donovan 2003). Adams and Geuens (2007) have recently showed that, among adolescents in Belgium, an unhealthy food product received better results in combination with an unhealthy slogan than with a healthy one, and vice versa (Adams and Geuens 2007). Highly concerned adolescents responded more favourably to a healthy slogan in terms of attitudes.

Other lessons learned from the reviews of social marketing of nutrition-related behaviours and programs aimed at other health behaviours are:

Customer as the focus: Essentially social marketing campaigns have the "customer" (the public) as the focus of the campaign. They start from where people are and focus on what support they need to make behavioural changes. Social change campaigners now realise that an approach focused entirely on alerting the public to the dangers of certain health-related behaviours is often inadequate in fostering changes in attitudes, opinions and, above all, behaviours. Social campaigns conceived simply to educate or admonish ("victim-blaming") often turn out to be relatively ineffective.

Appropriate, consistent messages: Appropriate messages are a key feature of effective social marketing (Sheehan 2005). Not only do they have to be culturally tailored to a target group, but they must also be well accepted by service providers and other stakeholders so that messages are delivered consistently in a collaborative manner, and do not compete with other messages.

Personal relevance: It is important to establish personal relevance (an emotive connection) and to initiate people to take the desired action, increasing people's readiness to change. The challenge is to persuade people to change their behaviours without giving up activities they truly value (Kline 2005). In other words the perceived benefits, particularly any immediate ones, should be maximised and the perceived short-term costs faced by the target audience minimised (Andreasen 2002).

Use of existing settings: Existing settings that low-income populations, in particular, come into contact with on a regular basis are more successfully used to present a social marketing intervention than trying to encourage people to attend new settings and services (Havas et al. 1998). Use of existing settings or communication channels means that messages are perceived as being credible.

Use of community groups: Use of community groups to support behaviour change efforts and targeting those who have a reason to care have been highlighted as crucial components (Sheehan 2005). Early engagement and involvement in the campaign planning and development is also important.

Cultural appropriateness: Different cultural understandings and models of health are of central importance to behaviour change. In studies with Maori and Pacific Islanders in New Zealand, Sheehan (2005) has highlighted that culturally-tailored social marketing interventions that include community control, community participation and leadership are critical features of effectiveness.

Build partnerships: Engagement of organisations outside of the health sector is needed. Joint commitment and a co-ordinated approach across government, industry and voluntary sectors is needed, with strong partnerships between agencies.

Formative research: The report by Sheehan (2005) also emphasised the importance of formative research. Customs, norms, values, and leadership patterns must be considered in formulating social change strategies targeted on society as a whole or on a single community. People need to be listened to, to find out what's in it for them.

Research and evaluation: As well as formative research, ongoing monitoring and evaluation in addition to workforce development is needed to support social marketing campaigns (Sheehan, 2005). Research and evaluation have been found to be vital ingredients of the *Slip! Slop! Slap!* and *SunSmart* campaigns in Australia (Montague et al. 2001).

Long-term focus: Permanent, large-scale behavioural change is best achieved through changing community norms, which can take generations. Larger campaigns often move from raising public awareness in initial phases to attempting specific behaviour change in later phases (Thornley et al. 2007). Consistency and continuity was identified as the other foundation basis for *Slip! Slop! Slap!* and *SunSmart* campaigns in Australia (Montague et al. 2001).

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SHPN: (CHA) 090049